

GAO

United States General Accounting Office

Total Quality Management
Participant Manual

December 1992

Team Member

148189

THE UNIVERSITY OF CHICAGO
LIBRARY

1954

**QUALITY
IMPROVEMENT
PROCESS**

***Team Member
Manual***

Copyright © 1988, 1991, QUALTEC, INC., All Rights Reserved

Team Member Manual

This team member manual was developed to provide the Quality Improvement (QI) team member with an understanding of the Quality Improvement Problem-Solving Process and its relationship to Total Quality Management (TQM). It also provides the team member with a Ready Reference Guide to enable effective participation on a QI team. Your grasp of the Quality Improvement Process (QIP) and its many applications is the key to a successful Quality Improvement Team and your personal development.

Contained in this manual are many new ideas that will assist you in your role as a team member. As a quick reference to the tools and techniques, an appendix has been added to provide you with a brief description of each tool and technique, and a reference page number for more in-depth applications.

Good Luck!

Note:

This manual was developed by Qualtec Quality Services. As GAO gains more experience, we will modify the manual to reflect those experiences and our increased knowledge.

September 1992

Purposes of the Team Member Manual

- To provide the team member with an overview of Total Quality Management (TQM).
- To provide the team member with an understanding of the problem-solving process and its many applications.
- To introduce the team member to the Quality Control (QC) tools which enable the team to speak with facts.
- To provide a basis for self-improvement and personal growth.

Table of Contents

| | |
|-----------|--------------------------------------|
| Unit 1: | Concepts of Total Quality Management |
| Unit 2: | Quality Improvement Teams |
| Unit 3: | QI Story and Problem Solving |
| Unit 4: | Getting Started: The First Steps |
| Unit 5: | Pareto Chart and Problem Statements |
| Unit 6: | Ishikawa ("Fishbone") Diagram |
| Unit 7: | Other QC Tools |
| Appendix: | Glossary of Terms |

Unit 1

Concepts of Total Quality Management

Overview

This unit will introduce you to the concepts of Total Quality Management (TQM). It will enable you to assess how your objectives relate to TQM.

Learning Objectives

Upon completion of Unit 1 you will be able to

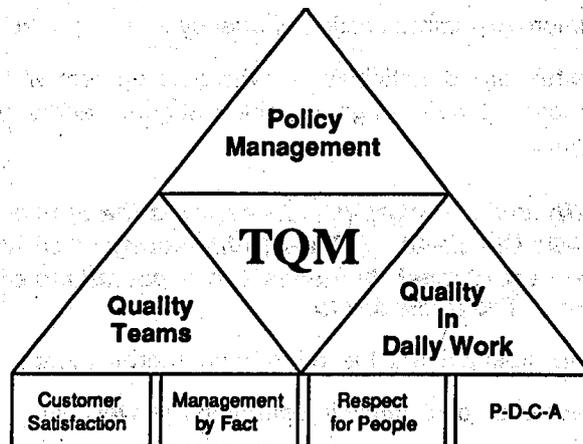
1. Label the TQM triangle.
2. Identify the four principles of TQM.
3. Apply the principle of Customer Satisfaction.
4. Define the principle of Management by Fact.
5. Identify your customers.

Total Quality Management

What Is Total Quality Management?

Total Quality Management, or TQM, is a way of ensuring customer satisfaction through the involvement of all employees in learning how to reliably produce and deliver quality goods and services.

Total Quality Management Triangle



TM-1-03.1

Our goal is to improve internal and external customer satisfaction through total quality control. TQM is how we work toward that goal. The three components that make up TQM are Quality Teams, Policy Management, and Quality in Daily Work.

1. **Quality Teams provide a structured environment for employees to work together toward**
 - improving the quality of products and services.
 - developing and leveraging the skills and abilities of employees.
 - promoting communication and teamwork.
 - enhancing the quality of work life.
2. **Policy Management targets the achievement of breakthrough by concentrating agency efforts and resources on a few priority issues to**
 - increase performance levels.
 - improve communication of agency and unit direction.
 - attain broad participation in the development and attainment of long-term goals, mid-term goals, and short-term goals.
3. **Quality In Daily Work (QIDW) requires the application of Plan-Do-Check-Act (P-D-C-A) philosophy to activities necessary to meet the needs and expectations of customers. The goals are to**
 - maintain gains achieved through improvement projects.
 - achieve consistency in operations as well as results.
 - clarify individual contributions toward achieving customer satisfaction.
 - improve daily operations.

Please note that the scope of this manual is limited to the first component, Quality Teams.

Four Principles of Total Quality Management (TQM)

1. **Customer Satisfaction** means not only satisfying the needs and reasonable expectations of customers, but having an attitude that puts the needs of the customer first. (A telephone call from someone who uses one of my products – my customer – is not an interruption of my work; it *is* my work.)
2. **Management by Fact (often referred to as "speaking with facts")** means that not only managers, but all employees, manage the work they do by collecting objective data and making decisions based on this information.
3. **Respect for People** means that each of us needs to listen to and support the capacity of all other employees for self-motivation and creative thought.
4. **P-D-C-A (Plan-Do-Check-Act)** is a work philosophy that emphasizes four phases of activity:
 - Plan what to do
 - Do it
 - Check what you did
 - Act to prevent error or improve the process

Customer Satisfaction

What Is Customer Satisfaction?

Customer satisfaction is the heart of TQM. We all serve our external customers, but most of us also have internal (next process) customers. Everyone we serve is our customer and deserves to be treated with the same care as the ultimate customer.

How Do We Achieve Customer Satisfaction?

1. We divide up our work process into inputs, activities, and outputs.
2. We identify our next process customers as those who receive our outputs.
3. We work with our customers to determine what the *valid requirements* are for our process outputs.
4. On the basis of the valid requirements, we develop *quality indicators* through which we can monitor our performance in an ongoing way.
5. We take corrective action when necessary to satisfy customer needs.

When Do We Use Next Process Customer?

"Next process customer" should be the motto which guides all our interactions with other units or areas that we impact within the agency. It can help us get a new perspective on what we do and how we do it.

Why Do We Use Next Process Customer?

We use next process customer to bring the necessity for quality to every aspect of our work, both internally (within GAO) and externally.

The Customer Satisfaction Philosophy

- 1. We are in a long-range relationship with our customers.**
- 2. We must help our customers identify and satisfy their needs and wants.**
- 3. We must realize that these needs and wants will change and evolve.**
- 4. We must keep the lines of communication open between suppliers and customers.**

Valid Requirements

What are Valid Requirements?

1. Valid requirements are standards of quality work agreed upon by customers and suppliers. Valid requirements must
 - Be current, realistic, and measurable.
 - Meet customer needs and reasonable expectations.
 - Meet agency responsibilities.
2. Valid requirements are usually simple statements of how a product should be (including measurement) to be useful to the customer; for example, a form legibly filled out and submitted with signature within 5 days of completion of the job.

Why are Valid Requirements Useful?

We use valid requirements to satisfy the needs and reasonable expectations of our customers.

How are Valid Requirements Applied?

In the ideal case, we open a clear channel of communication and negotiate the valid requirements with our customers. We start by asking them about their wants and desires; through questioning and consensus we narrow the focus to those requirements that they *need* and can *reasonably expect*. Once established, the valid requirements serve as both a goal and a guideline for producing quality products.

When are Valid Requirements Used?

We can use them to guide us in establishing or improving our work processes in general; we also use them in steps 1, 2, and 4 of the QI Story.

***Example of Negotiating Valid Requirements
In a Win-Win Fashion***

Your customer *wants* you to supply a report on the first day of each month, two weeks in advance of when you know it is needed. If you comply with your customer's request, this "safety cushion," as you see it, may cause your department undue stress. It may also result in a less-than-quality product.

As you negotiate the timeframe with your customer, you open communications. You realize your customer must perform several operations on the report and distribute five copies before the report is analyzed in a department staff meeting. Your customer now understands that you, as the supplier, have three other reports due at the same time each month. Some of the information your customer requests in the report is dependent upon the completion of the others.

Further negotiations reveal the staff meeting is the 15th of the month. Your customer *needs* the report four days prior to that meeting. You mutually agree upon the 11th day of the month as the due date.

The Valid Requirement is that the report get to your customer no later than the 11th of each month.

Checking the Valid Requirements

1. Consider a specific product. Get customer input. When all the customer's "needs" have been *listed*, look it over *together*.
2. Initially, the "wants" (those which enhance the success) should be saved until the "needs" are addressed completely. Mutually agree on these items.
3. Next, apply the RUMBA criteria to the list of needs. A need which meets all five RUMBA criteria becomes a "Valid Requirement."

What is the RUMBA? In this case, it is an acronym for five criteria that you can use to confirm the *existence* of a valid requirement.

RUMBA is defined as follows:

| | |
|-----------------------|---|
| Reasonable | You or your work group can meet the requirement (it does not violate agency procedures, job accountabilities, etc.). |
| Understandable | The customers verify that you understand what they are requiring from you or your work group. |
| Measurable | The specification is measurable – in some way you can <i>objectively</i> determine the degree or frequency of meeting the requirement. |
| Believable | Your co-workers will be agreeable to <i>strive</i> for that level of achievement. |
| Achievable | You <i>can</i> meet the requirement. If not, you may need to renegotiate the specifications as facts and actual data may later dictate. |

4. A "want" which meets all five RUMBA criteria is also a valid requirement.

To apply RUMBA, simply take each of the agreed upon wants and needs and ask the following:

Is this

- reasonable? (review definition) Y/N
- understandable? " Y/N
- measurable? " Y/N
- believable? " Y/N
- achievable? " Y/N

If all answers are "yes," then that one requirement is valid. Any *NO* answer implies the need for further negotiation until it becomes a *YES* answer. If it cannot become a *YES* answer, then the requirement is not a valid one and should not be accepted as such. Again, *Win-Win* negotiation and effective communications are the key.

Management by Fact

Management by Fact means managing by using data. In this manner, we can make the best possible decisions in delivering quality products and services to our customers.

What is Data?

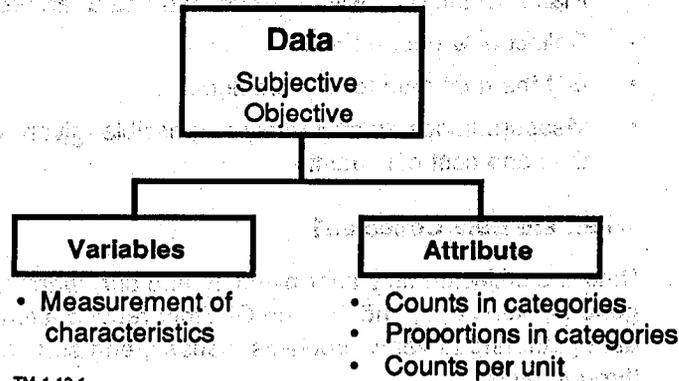
1. Webster defines data as "facts or figures from which conclusions can be drawn; a basis for reasoning, discussion or calculation."
2. Information collected about a product, service, process, person, or machine is called data.
3. Data (facts), when properly organized and analyzed, provide useful information and serve as the basis of decision making and action.
4. Data can be *subjective* (based on experience, intuition, gut feel, opinion, or observation) or *objective* (based on verifiable external events). Data may be represented in either words, pictures (graphs), or numbers.
5. In our search for objective data, numbers become very important. There are two broad categories of numerical data: *attribute* and *variables*. Understanding the categories and their differences helps us to use each effectively.
 - a. Attribute data describes a particular characteristic being measured. These data depend on counting occurrences that have certain characteristics, and they represent conformity or nonconformity with some quality characteristic. Attribute data are based on counts of the number of times a particular event is observed (for example, classes/categories of products, items, or services; number of defects; proportion of nonconforming items).

- b. Variables (continuous) data is continuous data that shows degrees of variation when measuring a characteristic of a product, service, or process and computing a numerical value from two or more measurements of data. The measurement is actually of a quality characteristic such as diameter, age, weight, lifetime of a product, or other values of a variable.

When it is important not only to identify and rank items, but also to precisely measure the distribution (the distance or interval between them), we must collect "variables data." If attribute data is black or white, then variables data is concerned with measuring the shades of gray. Not only do we identify our data by category, but we measure "distance" (pounds, feet, rate of disabling accidents, etc.).

This type of data is usually more expensive to collect (after all, to find out whether a customer is over or under age 50 is a lot less time consuming than finding the actual date of birth and calculating age), but it provides a lot more information on the subject.

Graphically, it looks like this:



TM-1-13.1

Why are Data Collected?

Data are collected to

- quantify the present situation (baseline) as well as future changes to be able to compare the two.
- identify improvement opportunities.
- analyze root causes and select countermeasures.
- track a process and/or a countermeasure.
- explain a problem/opportunity clearly to others.
- enable us to "speak with facts."

How are Data Collected?

Data are collected through the use of standardized forms called Checksheets. They are collected with consideration of *STRATIFICATION*, the breaking down of the total area of concern into smaller related functions or items. Generally, data should be collected at the smallest grouping practical; that data should include *VARIABLES* data when available.

When you plan for data collection,

- Identify what you want to know.
- Select the proper data collection technique.
- Plan how the data will be processed and analyzed.
- Collect only needed data.
- Get the right data for the problem.
- Measure things as accurately as possible, given reasonable time and cost constraint.

When are Data Collected?

Data are collected only after planning and only when needed. In general, steps 2, 3, and 4 of the QI Story require attention to data gathering to verify problems, causes, and countermeasures through facts.

Quality Indicators

What are Quality Indicators?

Quality indicators are measures of how well we are meeting our customers' needs and reasonable expectations. Put another way, they are measurements of the degree and/or frequency of conformance to valid requirements. Above **80 percent** conformance, we should focus on non-conformance to aid our improvement efforts.

Some examples of quality indicators are

- Number of forms submitted late
- Number of days between DP2 and DP3
- Number of days to receive travel reimbursement checks
- Number of typing errors in first draft of memos

Why are Quality Indicators Useful?

Quality indicators help us measure the gap between what is and what should be — present performance versus customers' valid requirements. They allow us to meet *measurable* criteria of valid requirements.

How are Quality Indicators Applied?

They are used to establish the current status (a baseline) and to track the number and/or percentage of errors, changes, or improvements.

When are Quality Indicators Used?

They are used in steps 1, 2, and 5 of the QI Story as we identify our theme or problem area.

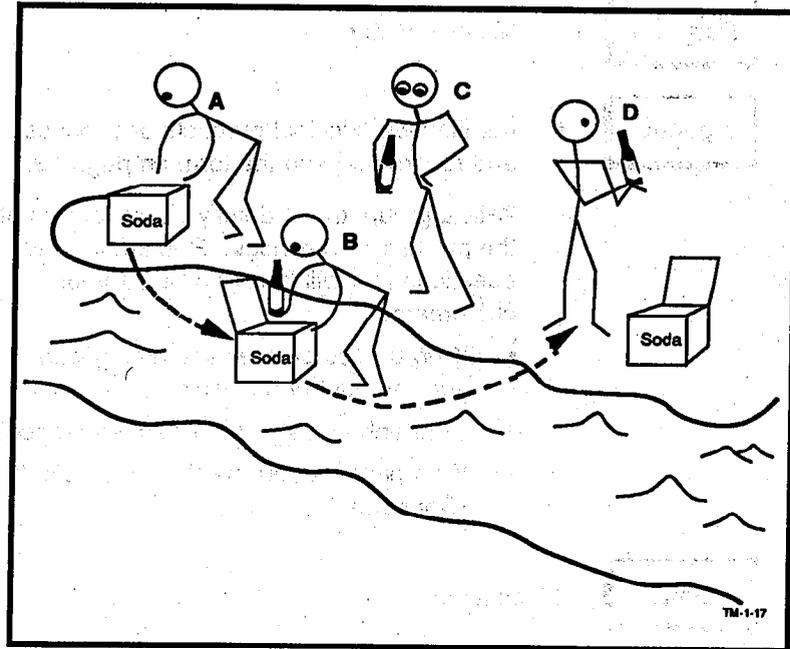
Identifying Customers

A customer is typically thought of as the consumer or end user when, in fact, the customer is also the next person or groups in the work process to receive the output (product or service) and modify or act on it.

External customers are those consumers (end users) whose valid requirements will be met by your product or service. To satisfy external customers, you must also meet the valid requirements of your **internal customers**, those within your organization who make enhancements or add value to the product or service you provide. Immediate supervisors may also be customers, although they generally review and support what is being produced, in effect portraying the role of co-supplier to the work process. Someone downstream in the process actually uses or modifies the output of the process. That person or group is the **next process customer**.

The illustration on page 17 depicts the external customer (D) as the consumer (end user) of the soda product. To meet that customer's valid requirements, the soda company must follow a work process which includes packaging the product. Worker (A) designs and builds cartons to package the soda. His/her downstream, **next process customer** is the bottling department (B) which has the following valid requirements: A carton capable of holding 5 pounds in weight, 12 inches tall, with spaces of 4 x 4 inches to hold 24 bottles. The supervisor's (C) role is to review and support the total process by assisting in provision of appropriate systems and structures to ensure conformity to valid requirements.

Downstream Concept of Next Process Customer



- A. Worker
- B. Bottling department
- C. Supervisor
- D. External customer

Exercise

Purpose

Identify customers.

Agenda

- Identify two principal products or services and record them on the form on page 19.
- With a group, try to identify all customers of the products or services. Remember, the questions that will help you target your customers:
 - Who utilizes or does something with your product or service?
 - Who enhances your product or service?
 - Who pays for your product or service? (Consumer)

Limit

15 minutes

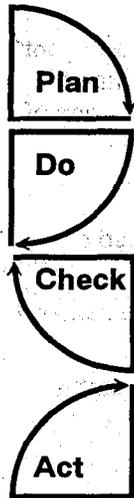
Product/Customer List

| Product/Service | All Customers |
|-----------------|---------------|
| | |
| | |

Unit 2

**Quality
Improvement
Teams**

How Is P-D-C-A Done?



You begin by setting goals based on **customer needs** and planning how to achieve the goals.

Continue by implementing or trying out what you have planned to see how it works.

During and after "doing" it, you gather and analyze data to find out what happened, what worked and what didn't (are you closer to your planned goal?).

On the basis of the analysis of the implementation results, act to improve the process.

When Is P-D-C-A Used?

The P-D-C-A cycle is a concept that can be applied to any process, from planning your annual vacation or preparing a meal, to intricate technical work procedures. It is also the concept that underlies the **QI Story**— plan for improvement, institute improvement, check the results, and act to further improve or standardize. It helps us keep on track as we solve problems and make continuous improvement.

Facilitator Role

The basic function of the **facilitator** is to act as a "change agent" to help management adapt to the cultural change associated with TQM and as a consultant to the team leader in the areas of group dynamics and the QI process tools and techniques.

The facilitator's roles include the following:

- **Communicator** — Keeps all in the area informed of activities.
- **Coordinator** — Supports supervisors, trains teams, and links to other departments.
- **Promoter** — Keeps up to date on QI and team status.
- **Teacher** — Instructs in the QI process and tools/techniques.
- **Coach** — Serves as a support and resource person to managers, supervisors, team leaders and team members.

To help the team leader, the team facilitator may

- Aid the team leader in preparing for meetings.
- Consult on the use of tools/techniques.
- Recommend the use of staff specialists or experts or other training resources.
- Share the experiences and results of other teams.
- Critique the effectiveness of team meetings with the team leader.

Manager Role

The manager can assist the team in many ways. Initially, it is likely that the facilitator will provide more direct assistance to the team, especially with the problem-solving process. Over time, however, the supervisor should become the coach for the team.

It is the manager's job to

- Coordinate Team Activities

The manager plays an active role in making sure team meetings focus on problems which relate to department objectives, that they retain quality leadership and facilitation, that members are properly chosen and trained, and that the functioning of the team remains at a high level.

- Advise on Opportunity Selection

The manager serves as an advisor and consultant to the teams, giving them suggestions on possible problems to select, how to set time limits, and how to track and measure progress towards solutions. This is done without *directing* the team on what they should work on.

- Provide Needed Resources

The manager supports the functioning of the teams by making sure that they have necessary resources, including time to meet, a meeting space, and all other materials necessary for their smooth operation such as data, work schedules, materials, and support of technical resources.

- Coach on Problem Solving

Perhaps most important, the manager serves teams as a coach: acting as a technical problem-solving resource, motivating teams to press ahead through tough problems, and serving as mentor for team presentations.

- Assist in Implementation of Solutions

The manager responds promptly to proposed solutions, helps teams through the difficult early stages of implementation, and supports the lasting benefits of change.

- Recognize Team Achievement

Praise, support, feedback, and continued direction to teams are constant duties of the manager to reinforce quality achievement and keep efforts alive. Recognition is both formal and informal

Types of Teams

Quality Teams are the basic building blocks of TQM. There are four major types of teams besides the GAO-wide Quality Council:

Functional Team (voluntary)

Team members are from a single functional area, which may be a natural work unit. Membership is voluntary and the team is ongoing. The ideal team size is 6 - 8 members.

Cross-Functional Team (voluntary)

Team members are from more than one functional area and meet to work on improvement opportunities that cut across functional lines. Like the Functional Team, members are voluntary and the team is ongoing.

Task Team (assigned)

Task Team members are also from one or more functional areas. The team is formed to solve a specific problem or group of problems and then disband. Members are assigned to a task team based on background and experience with the problem(s) being examined. The members and the task are typically assigned by management (Unit Quality Council).

Unit Quality Council (Lead Team)

- **Region/Unit Quality Council**

Led by a director, this team functions as a Steering Committee — setting policy, guidelines, handling overall logistics, communication, etc. for teams operating under it.

- **Issue Area Quality Council**

Issue Area Councils, composed of an issue area manager and staff, provide the same kind of coordinating/policy role at the issue area that Unit Quality Councils do overall.

Unit 3

QI Story and Problem Solving

Overview

This unit will introduce you to the QI Story and the seven step method of problem solving.

Learning Objectives

Upon completion of Unit 3, you will be able to

1. Identify the seven steps of the problem-solving process.
2. Recognize the various tools and techniques which are used to support the problem-solving process.
3. Explain the significance of the QI Story as a standard way for the team to communicate its progress, to support the management presentation, and to reinforce the use of statistical techniques.
4. Recognize the seven Quality Control (QC) tools and name the three QC tools which are most likely to be used in the problem-solving process.

The QI Story

What is the QI Story?

The Quality Improvement problem-solving process is a systematic, data-based approach to problem solving. The QI Story is a structure to help illustrate the steps to be taken by a team in the improvement process. It provides a standard way of communicating team progress. The vehicle used to document this process is known as a "story board," which is essentially a structure allowing a team to display its work in a standardized fashion. (The QI Story is illustrated on page 4.)

Why is the QI Story Useful?

- It helps the team to organize, collect, and analyze information and to monitor how they are doing.
- It encourages the team to obtain and communicate information to non-team members.

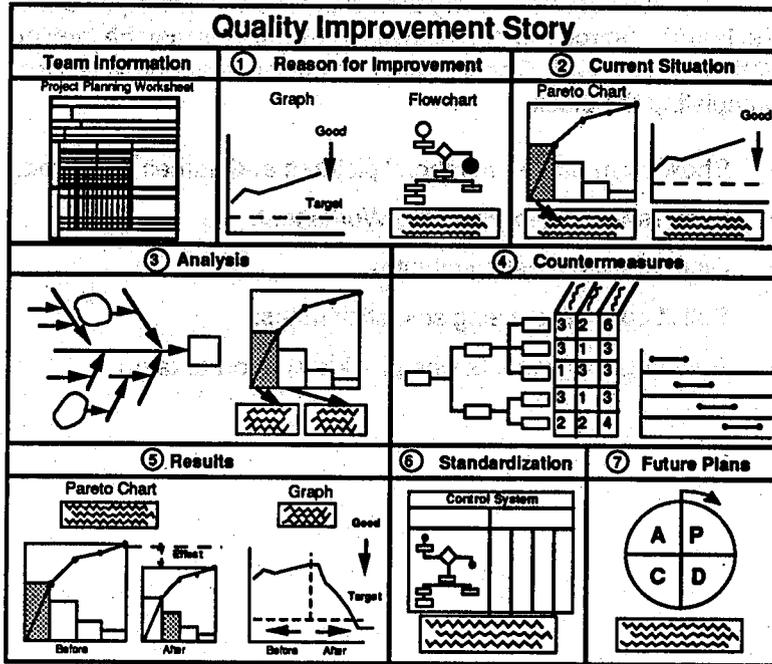
How is the QI Story Used?

The QI Story is a guide as we go through the problem-solving process; it serves as a guide for planning, doing, and checking. If we follow it step by step, it provides both the team and others with a clear picture of the logical process used for improvement.

When is the QI Story Used?

We use it at every stage of the team's activity and every step of the improvement process.

The QI Story



TL-1-88.1

Team Information

The first block of the QI Story is designed to provide a place for the team to "introduce" themselves to whomever may be looking at their story board. The following suggestions are provided for completing the block:

- Show team name, members' pictures and names if desired.
- Post Team Project Planning Worksheet.
- Display team meeting minutes.
- Solicit comments using self-stick notes.
- Recognize individuals who provide support to team.

Team Project Planning Worksheet

What Is the Project Planning Worksheet?

The Team Project Planning Worksheet is a form used by teams to record their meetings, set goals for their activities and track their progress. An example is provided on the following page.

Why is the Project Planning Worksheet Useful?

The team can see the number of meetings they've had and assess progress in meeting the projected targets and goals for each step of the QI Story.

How is the Project Planning Worksheet Done?

Ideally, a facilitator should attend all team meetings and review the worksheet with the team. Then, based on team and facilitator experience, projected completion dates should be set for each step of the process. As each step is completed, the "actual" date should be entered.

When is the Project Planning Worksheet Used?

Each new team, and any team beginning a new theme, should complete the worksheet.

| Team Project Planning Worksheet | | | | | | | | | | | | |
|---------------------------------|------|------|---|-----|------|------|------------------|-----|------|--------------------------------------|------|--|
| Theme (Problem Area) | | | | | | | | | | | | |
| Team Work Location | | | | | | | | | | | | |
| Team Name | | | | | | | | | | | | |
| Duration | | | Mo./Yr. () through Mo./Yr. () | | | | Total Months () | | | | | |
| | | | | | | | | | | Team Information | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| No. | Date | Time | Att. | No. | Date | Time | Att. | No. | Date | Time | Att. | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | Comments (How each step was done) | | |
| Mo. & Yr. | | | Schedule (<input type="checkbox"/> Projected <input type="checkbox"/> Actual) | | | | | | | | | |
| Reason for Improvement | | | | | | | | | | | | |
| Current Situation | | | | | | | | | | | | |
| Analysis | | | | | | | | | | | | |
| Counter-measures | | | | | | | | | | | | |
| Results | | | | | | | | | | | | |
| Standard-ization | | | | | | | | | | | | |
| Future Plans | | | | | | | | | | | | |

Note: Place an asterisk (*) after the presentation date.

TM-3-07

Step One: Reason for Improvement**Objective**

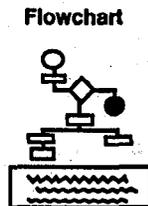
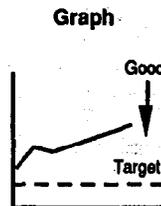
Identify a theme (problem area) and the reason for working on it.

Key Activities

- Research for themes:
 - Survey internal/external customers.
 - Identify what the team already knows (Brainstorm).
 - Review unit indicators.
 - Interview individuals from the work area.
- Consider customer needs to help select the theme.
- Set indicator to track the theme.
- Determine how much improvement is needed, using data.
- Show impact of the theme.
- Schedule the QI Story activities.
- Describe the procedure used in the problem area.

Helpful Tools/Techniques

- Graph
- Control Chart
- Process Flowchart
- Control System

Examples:

TM-3-08

Step Two: Current Situation

Objective

Select a problem and set a target for improvement.

Activities

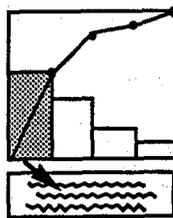
- Collect data on all aspects of the theme.
- Stratify the theme from various viewpoints.
- Select a problem from the stratification of the theme.
- Identify the customer's valid requirements.
- Write a clear problem statement.
- Use the data to establish the target.

Helpful Tools/Techniques

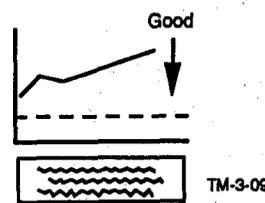
- Checksheet
- Histogram
- Pareto Chart
- Control Chart
- Graph

Examples:

Pareto Chart



Graph



TM-3-09

Step Three: Analysis

Objective

Identify and verify the root causes of the problem.

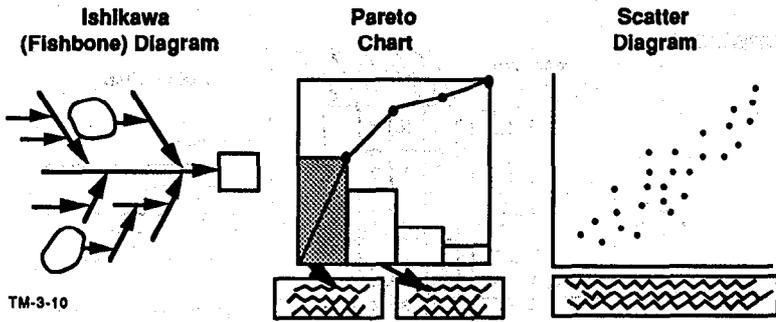
Key Activities

- Perform cause and effect analysis on the problem.
- Continue analysis to the level of actionable root causes.
- Select the root causes with probable greatest impact.
- Verify the selected root causes with data.

Helpful Tools/Techniques

- Cause and Effect Analysis
 - Ishikawa (Fishbone) Diagram
- Checksheet
- Pareto Chart
- Histogram
- Graph
- Scatter Diagram

Examples:



Step Four: Countermeasures

Objective

Plan and implement countermeasures that will correct the root causes of the problem.

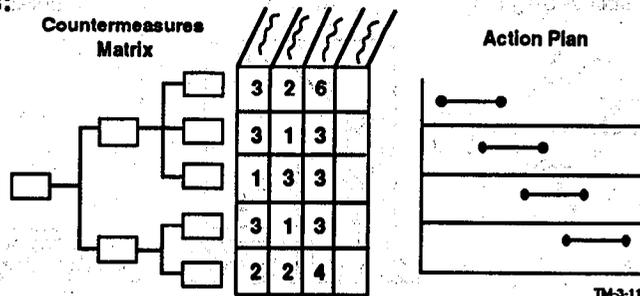
Key Activities

- Develop and evaluate potential countermeasures which
 - Attack verified root causes.
 - Meet customer's valid requirements.
 - Prove to be cost beneficial.
- Develop an Action Plan that
 - Answers who, what, when, where, and how.
 - Reflects the forces needed for success.
- Obtain cooperation and approvals.
- Implement countermeasures.

Helpful Tools/Techniques

- Cost Estimation
- Countermeasures Matrix
- Force Field Analysis
- Action Plan

Examples:



Step Five: Results

Objective

Confirm that the problem and its root causes have been decreased and the target for improvement has been met.

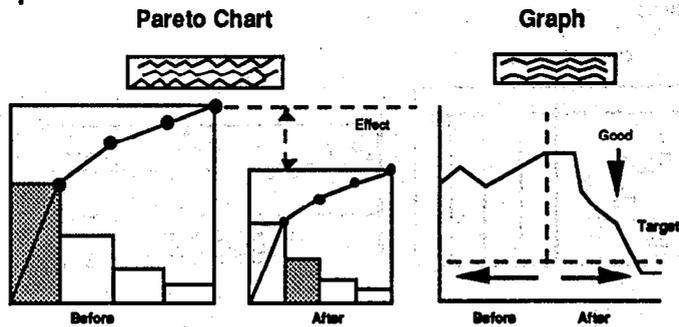
Key Activities

- Confirm the effects of the countermeasures, checking to see if the root causes have been reduced.
- Compare the problem before and after using the same indicator.
- Compare the results obtained to the target.
- Implement additional countermeasures, if results are not satisfactory.

Helpful Tools/Techniques

- Histogram
- Pareto Chart
- Control Chart
- Graph

Examples:



TM-3-12

Step Six: Standardization

Objective

Prevent the problem and its root causes from recurring.

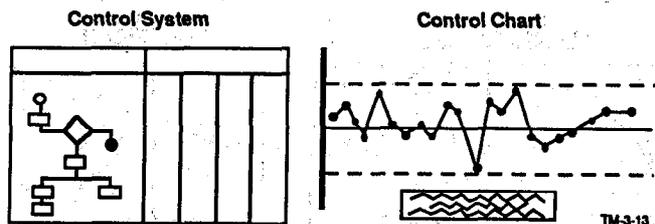
Key Activities

- Assure that countermeasures become part of daily work.
 - Create/revise the work process.
 - Create/revise standards.
- Train employees on the revised process and/or standards and explain the need or purpose.
- Establish periodic checks with assigned responsibilities to monitor countermeasures.
- Consider areas for replication.

Helpful Tools/Techniques

- Control System
- Control Chart
- Graph
- Procedures
- Training

Examples:



Step Seven: Future Plans

Objective

Plan what to do about any remaining problems and evaluate the team's effectiveness.

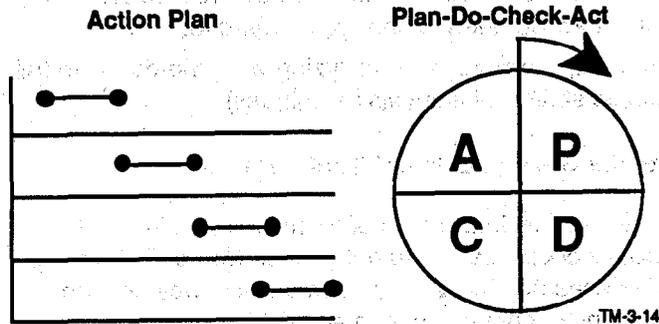
Key Activities

- Analyze and evaluate any remaining problems.
- Plan further actions if necessary.
- Review lessons learned related to problem-solving skills, group dynamics, and team effectiveness.
 - What was done well?
 - What could be improved?
 - What could be done differently?

Helpful Tools/Techniques

- Action Plan
- P-D-C-A

Examples:



TM-3-14

The Seven QC Tools

A vital part of the QI Story is the utilization of statistical quality control tools.

What are the Seven Basic QC Tools?

The seven basic QC (Quality Control) tools are common analytical methods used to solve problems. They are Checksheet, Graph, Pareto Chart, Cause-and-effect (Ishikawa or Fishbone) Diagram, Histogram, Scatter Diagram, and Control Chart.

Why are the Seven Basic QC Tools Useful?

The major use of QC tools is to provide objectivity and clarity in the way we do our work. They help separate opinions from data-based logic, thereby allowing us to "speak with facts."

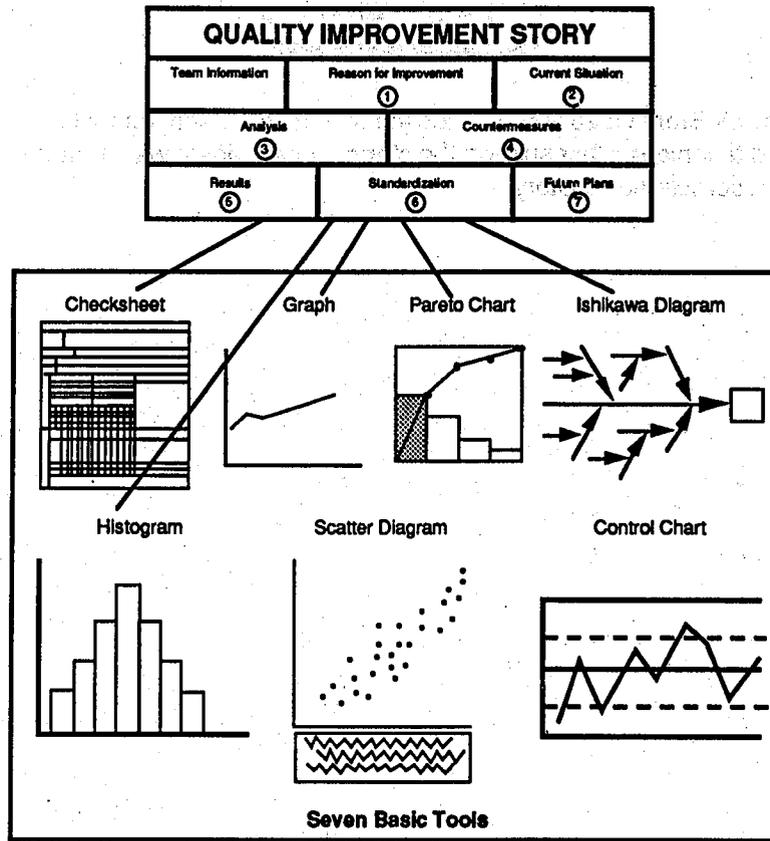
How are the Seven Basic QC Tools Used?

QC tools can be used by everyone. We are "speaking with facts" when

- we know what the work process involves: its inputs, activities, and outputs.
- we track the facts about this process and keep records which can be compared to discover how well we are doing and/or where we need to change or improve.
- we gradually learn ways of analyzing what the data can tell us (simple statistical analysis techniques).

When are the Seven Basic QC Tools Used?

They can be used by individuals or teams to examine and improve both work process and outcomes. Use of QC tools is particularly necessary for Quality Teams since they provide a common means of communication and decision making.



Eighty percent of all problems can be solved using just three of these seven basic QC tools: **Checksheet, Pareto Chart, and Cause-and-Effect (Ishikawa or Fishbone) Diagram.**

Ninety-five percent of all problems can be solved using the seven basic QC tools.

QI Story Video

The QI Story video summarizes the seven steps and the tools and techniques that support the steps. It provides a walkthrough of a completed QI Story.

Unit 4

**Getting Started:
The First Steps**

Overview

This unit provides guidance to the team in "getting started." The tools/techniques of Brainstorming, Multivoting, and the Theme Selection Matrix, along with the Checksheet, provide team members with an understanding of how to proceed with the first step of their QI Story.

Learning Objectives

Upon Completion of Unit 4, you will be able to

1. Explain how to get started, as a team, in selecting an improvement opportunity.
2. Identify the techniques of Brainstorming and Multivoting.
3. Use the Theme Selection Matrix.
3. Use the QC tool, "Checksheet."

Theme Selection Matrix

What Is the Theme Selection Matrix?

The Theme Selection Matrix is a tool which helps the team quickly select a theme on which to begin gathering data. Using its judgment, the team should select a theme which shows the need for improvement. The Theme Selection Matrix is shown on the following page.

Why Is the Theme Selection Matrix Useful?

The matrix allows the team to rank its themes by considering the impact on the customer and the need to improve. **Thus, the team is able to focus its energies on improvements which are customer oriented.** The matrix also helps the team achieve ownership and clarity in the selection of its theme.

When Is the Theme Selection Matrix Used?

The matrix is used after the team has reduced its list of themes to three to five items through Multivoting. The list is then placed onto the matrix and the team works to complete the remaining categories.

| Theme Selection Matrix | | | |
|---|--|---|---|
| Themes | Impact on Customer | X Need to Improve | = Overall |
| | | | |
| | | | |
| | | | |
| <p>Themes: The 4 or 5 remaining after the team has multivoted.</p> <p>Teams should consider only those themes within their responsibility and control.</p> | <p>Impact on Customer: A rating based on the team's present knowledge and judgment of the direct effect this theme has on customer satisfaction. (How severe is each occurrence?)</p> <p>Higher ratings are given to themes which have a more direct effect on customers.</p> | <p>Need to Improve: A rating based on the team's present knowledge and judgment of the difference between the present performance and that needed to meet the customer's valid requirements. (How frequently does it occur?)</p> <p>Higher ratings are given to themes with greater need to improve.</p> | <p>Overall: The product of Impact on Customers X Need to Improve. The theme receiving the highest ranking should be investigated setting an indicator and actually measuring the present level and comparing it to the valid requirements. If there is a difference, then the team should proceed. If not, it should investigate the next theme.</p> |

Scale: 1 None 2 Somewhat 3 Moderate 4 Very 5 Extreme

TM-4-08

Checksheet**What Is a Checksheet?**

A Checksheet is a form on which data collected systematically can be recorded in uniform manner.

Why Is a Checksheet Useful?

A Checksheet enables us to gather a variety of data in a systematic fashion. If the categories are complete, especially if they include the source, this tool can give us a clear and objective picture of the facts.

What Does a Checksheet Look Like?

An example of a simple Checksheet is shown on page 10. Other more complex Checksheets with which we are familiar include expense account forms, multiple entry ledgers, and payroll check attachments.

How Is a Checksheet Constructed?

1. Lay out the categories of information and data we wish to gather about the items on the checklist onto a standardized form or grid.
2. Determine the categories by asking such fact-finding questions as
 - What (what happens)?
 - Who (who does it, who receives it, who is responsible)?
 - Where (what place, what part, what section)?
 - When (what time of day, month, how often)?
 - How (how does it happen, how much, how long, etc.)?

To obtain categories for the Checksheet, use all the journalistic questions except "why?" Asking "why?" will mislead us into a search for causes when we are still trying to determine whether a problem exists and, if so, what it looks like.

Design the Checksheet to facilitate the collection of as many different kinds of data as would be useful. The team can brainstorm items and then refine the list through Multivoting. It is also helpful to gather a little data prior to setting up your Checksheet. You may identify the categories from this smaller sample.

3. Clearly indicate on the checksheet who collected the data and where, when, and how it was collected. In a sample, the total population from which the data was gathered should also be indicated.

When is a Checksheet Used?

The Checksheet is used whenever the team needs to collect data to help identify and quantify problems and improvement opportunities (themes), especially in steps 1, 2, 3, and 4 of the QI Story. The use of both checklists and Checksheets will minimize the risk of errors and facilitate the organized collection and analysis of data.

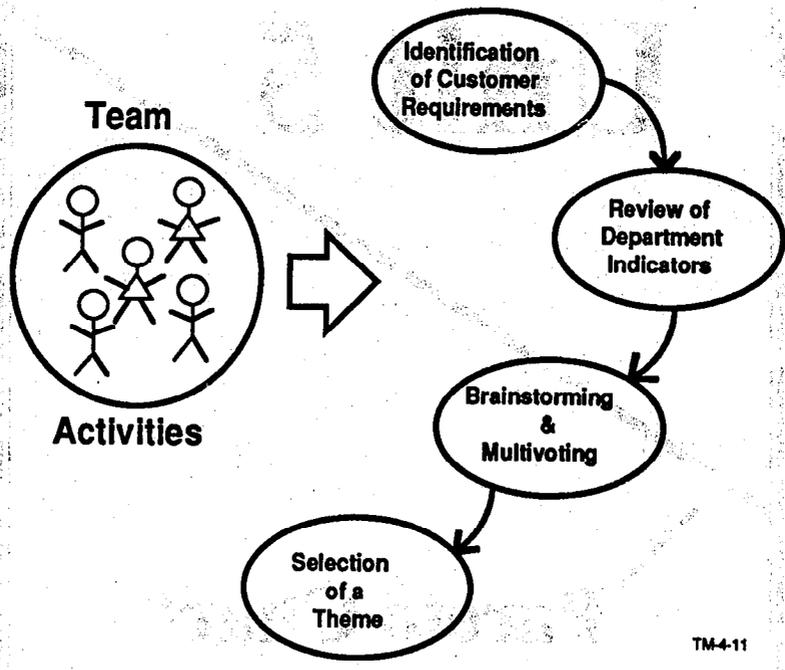
Plant Site
Packaging Line Interruptions, 1990

Source: _____
 By: _____
 When: _____

| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | Totals |
|---------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|------------|
| MAINTENANCE | A.M. | I | I | I | | | II | II | | III | | I | | 11 |
| | P.M. | | | | I | | II | II | I | III | III | | | 21 |
| POWER | A.M. | | I | | | | | | | | | I | | 2 |
| | P.M. | | | | | | I | I | | I | | | | 3 |
| RAW MATERIALS | A.M. | II | I | II | III | III | II | II | II | II | III | II | II | 78 |
| | P.M. | II | III | III | III | II | 173 |
| | | | | | | | | | | | | | TOTAL | 288 |

TL-1-98

The Focus for Getting Started



TM-4-11

Unit 5

Pareto Chart and Problem Statements

Overview

Unit 5 will introduce you to the Pareto Chart and Problem Statements.

Learning Objectives

Upon completion of Unit 5 you will be able to

1. Explain the Pareto Chart.
2. Construct a Pareto Chart.
3. Identify the criteria for evaluating the team's Problem Statement.

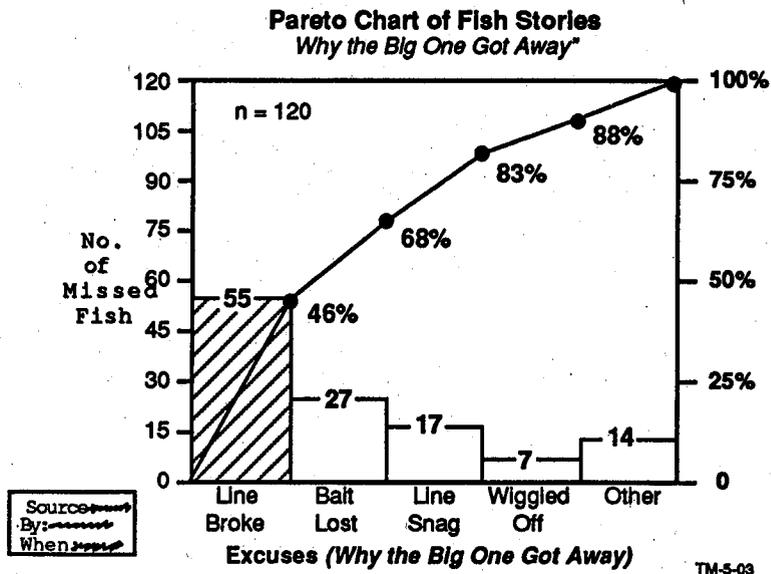
Pareto Chart

What is a Pareto Chart?

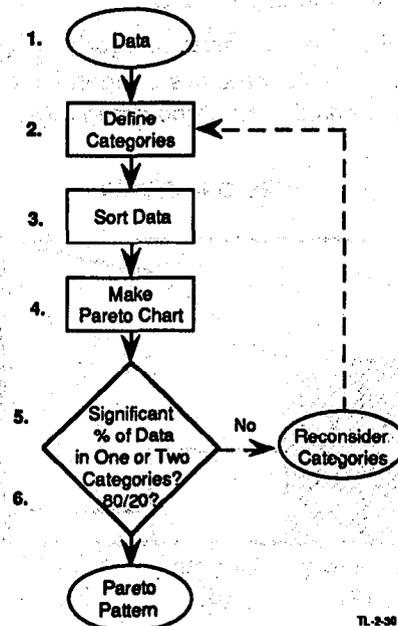
- Pareto analysis is a way of organizing data to show what major factor(s) make up the subject being analyzed. It is a search for significance.
- A Pareto Chart is a type of chart in which the bars are arranged, in descending order, from the left.
- The basis for Pareto analysis is the "80-20" rule; 80 percent of the problems result from 20 percent of the causes.

Why is a Pareto Chart Useful?

Arranging data on a Pareto Chart helps to highlight "the vital few" in contrast to "the trivial many." Selecting categories, tabulating data, ordering data, and constructing the Pareto Chart can enhance communication among team members and with management. It allows the team to select the component of the problem which will produce the greatest results. This component is then taken forward to the *Analysis* step of the *QI Story*.



How is a Pareto Chart Constructed?

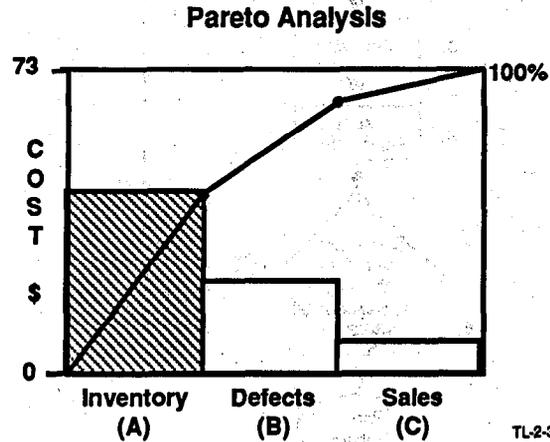


1. Identify what data are to be analyzed, such as defects.
2. Select the categories to be used (defects by shift, location, type), and sort the data into the categories; for instance, how many defects related to shift, location, and type.
3. If possible, further stratify the data; for instance, "shift" may be broken down into "day," "night," and "graveyard."
4. Make a graph with the bars ordered in decreasing frequency from the left.

Verify:

- Bars touching
- Left axis for actual data
- Right axis for percent of total
- Cumulative line from zero
- Second stage Pareto, if applicable

5. Check your graph for the Pareto pattern; a "flat" Pareto — categories with similar percentages — indicates the need for different stratification of the data.
6. Be careful not to mix dissimilar categories of problems on Pareto Charts. To illustrate this danger, look at the Pareto Chart below. Consider the three categories.



The categories are of three different types.

- A. **Inventory is a reduction problem.** We cannot do without inventory, but we would like to reduce the unnecessary portion of it. Category A can be subdivided into necessary and unnecessary inventory. Unnecessary inventory is a zero-base problem. It can then be compared to Category B.
- B. **Defects is a zero-base problem;** the ideal situation is to reduce it to zero (no defects).
- C. **Sales is an increase problem;** we want to know how to increase sales, not reduce them to zero. We should project how much of a product is possible to produce, then try to increase it to that amount.

Here are further examples of the three types of problems:

- Problems {
- Reduction Problem** *not zero, even ideally*
(examples: inventory, staffing, costs)
 - Zero Problem** *ideally zero*
(examples: defects, trouble calls, errors, etc.)
 - Increase Problem** *not zero, even ideally*
(examples: service reliability, KWH usage, sale of other products)

When is It Used?

Pareto analysis can be used to identify major factors in a subject being analyzed and to help prioritize and select counter-measures. It is a useful way of identifying problems in *Current Situation* step. It can also be useful in the *Analysis* and *Results* steps.

Exercise: Pareto Charting

Purpose

To construct a Pareto Chart.

Agenda

Using the information on page 8:

- Team 1 will construct a Pareto Chart for the type of defect.
- Team 2 will construct a Pareto Chart for the six different days of defects (without regard to individual defects).
- Team 3 will construct a Pareto Chart for the three different plants in which equipment failure occurs (without regard to individual defects).
- All teams will answer:

What do you suggest for further investigation?

Limit

25 minutes

Exercise Information

A Bowling Ball Company has been experiencing problems with its bowling balls. The company decided to do an analysis on the types of defects they were experiencing. Five defects were noted as occurring at least once.

A form was constructed to record each defect by plant and by day. The five defects and the company's costs to correct each occurrence were as follows (with corresponding symbols to be used on the form for an occurrence):

- X - cracked \$40
- O - scratched \$1
- C - chipped \$8
- # - burred \$3
- ★ - off-color \$15

Each occurrence of all defects created the same amount of inconvenience to each customer (about 3 hours). The results of recording the defects over a period of time gave the following data:

| Plant | Mon. | Tue. | Wed. | Thu. | Fri. | Sat. |
|-------|-------|------------|--------------|------------|-------|------------|
| A | o o x | c o o | o o x | o # # | o # ★ | o c ★ |
| | c o | o # ★ x | c o o c # | o ★ | ★ o c | o # o o |
| B | o # ★ | o o # | o # x | c # ★ | o o c | o # ★ |
| | c o | # o | o | # o o o | x o o | ★ o o |
| C | o o # | o ★ o | o o o | o # o | o c # | o c # |
| | # o c | # o c | # o c | ★ | # o o | o o o |
| | o | | o ★ | | | |

Problem Statements

A good Problem Statement describes in specific, concrete terms what the data has revealed. It describes the present undesirable situation while avoiding "hidden" solutions.

Criteria for a Good Problem Statement:

- **It states the effect.** It states "what" is wrong, not why it is wrong. Avoid "lack of" statements. These always imply solutions.
- **It focuses on the gap between what is and what should be.** The gap may be a change or deviation from the norm, standard or the customer's expectation.
- **It is measurable.** It says how often, how much, when.
- **It is specific.** It avoids broad and ambiguous categories like "morale," "productivity," "communication," and "training."
- **It is a statement.** Do not phrase problems as questions. This may tend to imply that the answer to the question is the solution. Your statement should not imply a solution or blame.
- **It focuses on the pain.** The Problem Statement highlights "how" people are affected, the areas of discomfort, hurt or annoyance.

Remember that writing problem statements will sometimes be difficult since the problems often seem "obvious." The Problem Statement summarizes steps 1 and 2 of the QI Story. The Problem Statement is the *effect* or head of the Ishikawa (Fish-bone) Diagram, which will be discussed in Unit 6.

Samples of Problem Statements:

1. Simple, basic statements that an individual might use:
 - My program won't run. (Who, What)
 - My car won't start. (Who, What)
 - My checkbook didn't balance two of the last three months. (Who, What)
2. Examples of Who, What, When and Where statements teams might use:
 - This customer has been billed incorrectly for 3 months.
 - There is an average of 3 typing errors per page on the Quarterly Report.
 - Accounts Payable missed its deadline 30 percent of the time in the first half of '90.
 - In August, the Time-Sharing system was down 16 hours more than the monthly average of 26 hours.
 - Data Entry overtime cost is 20 percent over budget.
 - The Computer Center missed its customer bill schedule 9 times in May.

Factors to Consider:

1. Problem statements should represent the **effect** of some problem, focus on the gap between "What is happening" and "What should be happening," have no implied solutions, focus on "the pain," and be measurable.
2. They do not include any "Why," "Lack of," "Due to" elements. However, some might be more specific.
3. After this the team can begin analyzing "What could **CAUSE** the problem?"

The Problem Statement Matrix

The Problem Statement Matrix shown below can be used to evaluate problem statements. This matrix should be used **after** the team has developed its Problem Statement.

| | | | | | | | |
|---|--|--|--|--|--|--|---------|
| (F) it focuses on the pain. HOW things are affected. | | | | | | | TL-5-16 |
| (E) it is stated in a positive manner. Avoids questions. | | | | | | | |
| (D) it is specific. Avoids broad categories. | | | | | | | |
| (C) it is measurable. | | | | | | | |
| (B) Focuses on Gap between "what is" and "what should be." | | | | | | | |
| (A) States the Effect NOT the Cause. | | | | | | | |
| Problem Statement (Who, What, When, Where, but NOT Why) | | | | | | | |

Problem statements do not need to meet all six categories. But, obviously, the more categories each potential Problem Statement meets, the clearer it is likely to be.

Unit 6

Ishikawa (Fishbone) Diagram and Countermeasures

Overview

Cause and Effect Analysis can be done by using different tools. This unit will introduce you to the Ishikawa, or "Fishbone" Diagram, which is the tool most commonly used.

Learning Objectives

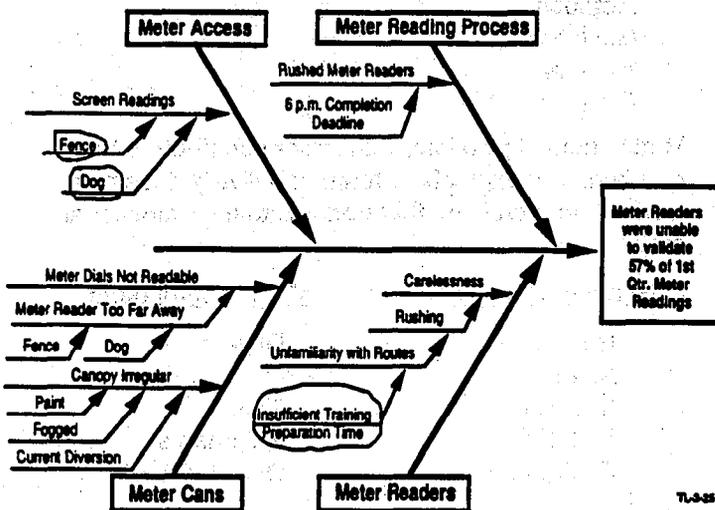
Upon completion of Unit 6 you will be able to

1. Recognize the Ishikawa Diagram.
2. Construct an Ishikawa Diagram.
3. Effectively use the Countermeasures Matrix.
4. Understand the need for Force Field Analysis and Action Plans.

Ishikawa (Fishbone)

What is the Ishikawa Diagram?

1. The main purpose of Cause and Effect Analysis is to help the team solve problems by the identification of a root cause so that corrective action can be taken.
2. *Cause and Effect Diagram* is a picture composed of lines and words designed to represent a meaningful relationship between an effect and its causes. The specific tool that we will focus on is called the Fishbone or Ishikawa Diagram.



Why is the Ishikawa Diagram Useful?

This tool helps teams reach a common understanding of problems and exposes gaps in existing knowledge.

How is the Ishikawa Diagram Constructed?

1. Draw the Fishbone Diagram. Start at the right, building the major categories (bones) toward the left.
2. Write the problem statement in the head (box) of the Fishbone. (Only the portion concerning the *effect* of the problem statement is necessary. This was identified in Step 2 through stratification.)
3. Determine the major categories of the Fishbone which relate to the effect. There are four ways to determine these categories:

a. First, you can review the "generic" categories of

- People
- Methods
- Machine
- Material
- Environment

Match them, if possible, with major contributors to the problem. For example, a team of delivery drivers is working on a problem that pertains to their functional area:

| <u>"Generic" Categories</u> | <u>Major Contributors</u> |
|-----------------------------|---------------------------|
| People | Drivers |
| Methods | Delivery Process |
| Machine | Truck |
| Material | Shipments |
| Environment | Delivery Route |

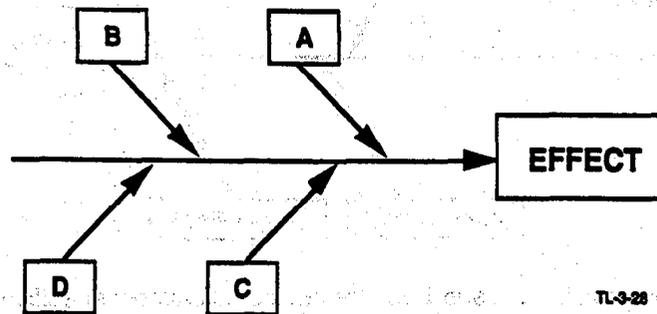
This functional team used drivers, delivery process, truck shipments, and delivery route as the major bones of their Fishbone.

- b. Second, if you are working with a process, you can break the process down into its major activities by creating a flowchart. Then assign each activity as a major bone. (See Fishbone on page 6).

- c. Third, the team can brainstorm possible causes of the problem. When brainstorming, it is often helpful to review at least one instance of the problem you will analyze in detail. Be sure you understand how it occurred and what the situation was when it occurred.

After the list is generated, segment the ideas into major categories. Name the categories and use them as major bones. For example, Operators, Animals, and Alarm Systems.

- d. Fourth, a Pareto Chart can be used to break down the effect into component parts, if the necessary data is available. These parts can then be used as major bones.
4. "Prioritize" the major categories in descending order, beginning with the category that has the highest likelihood of producing a potential root cause. For example:



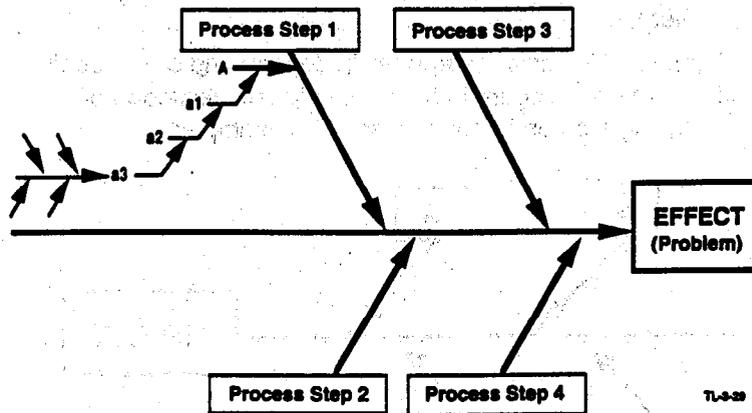
TL-3-28

In the Fishbone with four major categories or bones (shown above), the prioritization order would be A, C, B, D. Therefore, A is the major bone aligned most closely to the head of the fish, followed by C, B, and D.

This prioritization is especially useful later when the Fishbone is reviewed. If a reviewer can trace the logic flow in the construction of the Fishbone, then he or she can follow the team's thinking and offer better diagnostic advice to the team.

5. Once the Fishbone is set up with major categories, begin with the major category the team has identified as most likely to produce the actionable root cause (the category aligned most closely to the head of the fish) and begin to ask "why?"
 - Why does this occur?
 - Why does this condition exist?

Be sure to walk through the logic of your diagram in both directions, as shown below (This a1 is caused by this a2, which is caused by this a3). Then, in reverse, a3 caused a2, which caused a1. Often illogic will not surface until the second direction is tried. This completes one logic chain.



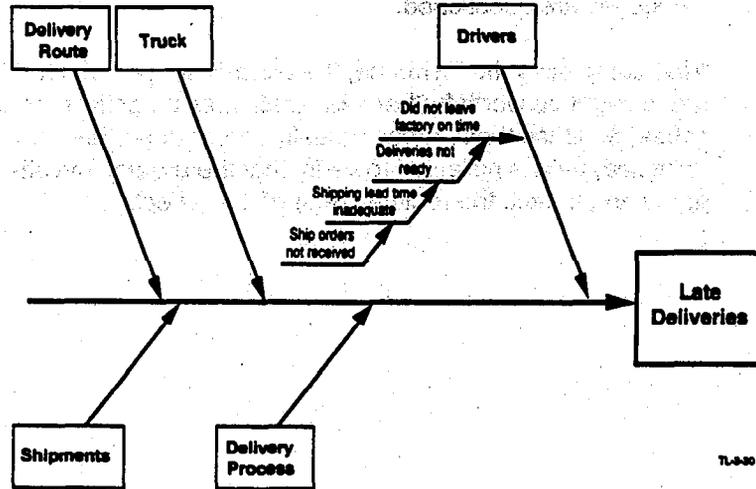
Now revisit each sub-bone for additional causes; specifically, move back to a2 and ask again, "Why does a2 occur?" Next, ask again "Why does a1 occur?" and continue this process of asking "why?" back to the major bone (Process Step 1). (See example of this process on pages 7 - 8.)

6. Complete the entire Fishbone before moving to Step 7.
7. Identify the likely, actionable root cause(s) and circle (or cloud) the last element in the chain.
8. *Verify*, with data, the most likely root cause. Teams should collect data to verify that these are indeed the root causes of the "effect."

If a potential cause seems to have many complicated subcauses, break into a separate diagram.

Here is an example of a Fishbone constructed by a QI functional team:

Fishbone — Late Deliveries



In the above example, begin the questioning: **“Why do drivers cause late deliveries?”** Proceed on this logic chain until it is no longer actionable or logical. After the chain is exhausted, retrace the logic from cause to effect. If the logic pattern is valid from both *effect to cause* and *cause to effect*, leave it on the Fishbone. If it is not logical, rework or remove it.

After completing one logic chain, move up to the next level and ask "why?" again. In the above example, the team had to stop at "Ship orders not received" because it was out of their control. The next area for consideration should be — Is there another cause for "shipping lead time inadequate" about which the team could ask "why?" If there is, continue asking "why?" If there is not, go up to the next level. Continue to work the Fishbone in this process until all major categories are questioned.

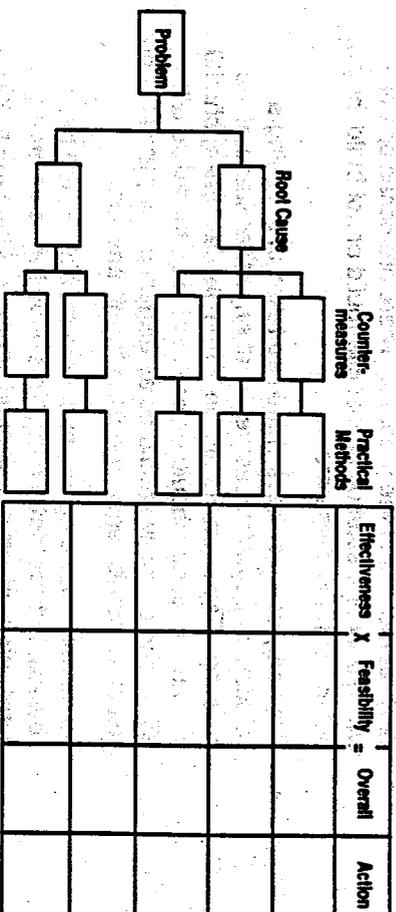
After completing the Fishbone, the team assesses which areas might be worth further examination as potential root cause(s). Once these areas (usually two or three) are identified, data is collected to verify that the area(s) investigated are, in fact, the root cause(s) of the "effect."

Choosing Countermeasures (Solutions)

- Sometimes those who have been involved in Quality Improvement talk as though the solution "falls out automatically" at the end of the process. There are occasions on which only one solution is possible (build or not build, buy or not to buy), but these are rare.
- Ordinarily as much care should be taken in choosing a solution, or countermeasure, as at any other stage of the process. The team should work from its data base, should research options, should be as creative as the issue will allow, and certainly should be as diligent in the pursuit of not just an adequate answer but the "right" answer.
- Some possible solutions, or countermeasures, will be obvious, but **brainstorming, interviewing, and management suggestion** are all good sources. Once the most likely have been chosen, they should be investigated. What will they involve, how many people, manhours, money, time, etc.?
- A principal tool at this state is the **Countermeasures Matrix**. After the team has selected the appropriate countermeasures, it will develop an **Action Plan** to implement these countermeasures. The term "countermeasure" is appropriate, because at this point, we are not sure that the action to be taken is really a solution. Only after the results are obtained and tracked over time, can we be sure of a "solution."

What is the Countermeasures Matrix?

It is a matrix of factors to help the team show the relationships among effect, root causes, and countermeasures. It also helps the team to evaluate which countermeasures should be implemented.



| Problem | Root Causes | Countermeasures | Practical Methods | Effectiveness | Feasibility | Overall | Action |
|--|---|--|---|--|---|---|---|
| This is the problem that needs correction. | These are identified on your cause and effect diagram and have been verified. | These are specifically aimed at the root causes and are within the learner's ability to implement. | A specific task needed to accomplish the countermeasure. A practical method is the how. | A rating based on how much the countermeasure will reduce the root cause. The higher rating goes to the more effective countermeasure. | A rating based on the firm, cost, work, acceptance, etc., needed to implement the countermeasure. The higher rating goes to the more feasible countermeasure. | The product of Effectiveness X Feasibility. This should serve as a ranking of the countermeasures for action. | Indicated by YES or NO if Action will be taken. |
| SCALE: 1 None 2 Somewhat 3 Moderate 4 Very 5 Extreme | | | | | | | |

TL-4-14

Why Is the Countermeasures Matrix Useful?

We use it to assure that the countermeasures address the significant root causes.

The Countermeasures Matrix is similar to the Theme Selection Matrix discussed in Unit 1. This Matrix guides the team in verifying root cause(s), identifying alternative countermeasures, and determining the effectiveness and feasibility* of their countermeasures. Other prioritization matrices may be used to evaluate countermeasures, but the example is one which can be easily used by most teams.

How Is the Countermeasures Matrix Constructed?

1. After verifying the significant root causes, the first two columns of the matrix may be filled in.
2. Next, the team identifies alternative countermeasures which address each of the root causes.
3. In the "practical methods" box, a specific task(s) is listed to accomplish the countermeasure.
4. The team then rates each of the countermeasures numerically by effectiveness and feasibility. The higher ratings go to those countermeasures which are more effective and more feasible.
5. The ratings are then multiplied and the countermeasures ranked for implementation according to their overall rating.
6. To determine how many of the countermeasures should be implemented, the team will need to consider its resources and its target for improvement. Sufficient countermeasures need to be implemented to achieve the target.
7. The team will indicate if the countermeasure will be implemented by writing either "yes" or "no" in the action column.

When Is the Countermeasures Matrix Used?

The Countermeasures Matrix is used after the team has identified those countermeasures which address the significant root cause(s).

* Effectiveness and Feasibility may be broken down into several components if the team feels they need it. Feasibility may be broken down into cost and time.

What is Force Field Analysis?

1. Force Field Analysis is a technique for pinpointing and analyzing elements which resist change (forces against) or push for change (forces for).
2. This technique helps a team to meet its objectives by planning to overcome the forces against and to make the maximum use of the available forces for.
3. Consider the following categories when doing the Force Field Analysis:
 - People
 - Environment
 - Hardware or Equipment
 - Dollars

| COUNTERMEASURE | → FORCES AGAINST → | ← FORCES FOR ← |
|----------------|--------------------|----------------|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Why is Force Field Analysis Useful?

Force Field Analysis helps teams to carefully analyze a situation when they are planning for change. Once the forces for and against change are identified, the team can make plans to use the available supporting forces and/or to overcome the existing forces against change which can prevent implementation of a solution.

How Is Force Field Analysis Done?

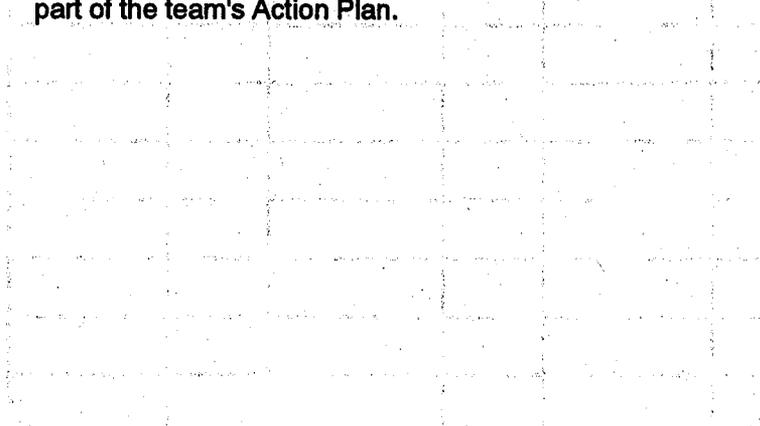
1. Identify the countermeasure, task, change, or concern.
2. Identify (through brainstorming) possible forces against; put them in a list.
3. Identify likely forces for (again list them).
4. Rank all listed items as high, medium, or low.
5. Match forces for which balance or overcome forces against.
6. List matching forces against and forces for on a chart.
7. List non-matching forces against and forces for and brainstorm any offsetting factors.

(Note: it is not necessary to come up with a supporting force for every force against.)

8. Identify items needing team action using your rankings (high, medium, low).
9. Develop an Action Plan.

When Is Force Field Analysis Used?

After a team has identified the most appropriate countermeasures, it can use Force Field analysis to assist in planning the trial implementation. The Force Field Analysis should be a part of the team's Action Plan.



What is an Action Plan?

1. The team's Action Plan is a technique that catalogs all the things that must be done to ensure a smooth and objective trial of the solution or improvement.
2. Although the Action Plan may have different formats, it should answer
 - Who
 - What
 - When
 - Where
 - How

The Action Plan should also consider the Forces (for and against) necessary for success. An example of an Action Plan is shown below:

| TASK ASSIGNMENT RECORD <small>(Review Daily; File for Future Reference)</small> | | | | | |
|---|--------------|-----------------------|--|---------------|----------------|
| | | | Prepared By _____ Date _____ Page ____ of ____ | | |
| | | | Loc'n/Proj: _____ Period _____ | | |
| No. | Task/Project | Priority/ Due Date | Assigned To | Date Assigned | Status/Remarks |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Unit 7

Other
QC Tools

Why is an Action Plan Useful?

It allows us to explain our ideas to management and peers, and to ensure an organized, objective implementation of the selected countermeasures.

How is an Action Plan Done?

- Analyze the proposed improvement or solution and then break it down into steps.
- Consider the hardware and numbers of people involved at each step.
- Brainstorm, if necessary, for other items of possible significance.
- Add to the list until the team feels it is complete.

When is an Action Plan Used?

We develop an Action Plan as part of the Countermeasures step. The plan will be one of the items that helps the team obtain cooperation and approvals, and effectively implement its countermeasures.

Overview

Unit 7 introduces the remaining QC tools. These include Graphs, Histograms, Scatter Diagrams, and Control Charts.

Learning Objectives

Upon completion of Unit 7, you will be able to

1. Recognize the appropriate Graphs, Histograms, Scatter Diagrams, and Control Charts with respect to the QI Story.
2. Recognize that Graphs, Histograms, Scatter Diagrams, and Control Charts, along with Checksheets, Pareto Charts, and Ishikawa Diagrams are methods to display, analyze, and
3. Identify additional GAO sources of help with the tools.

Aside from the information in this section, what assistance is available to GAO team members?

As GAO staff, you have several options for additional help with QC tools. You can

- Consult your unit's publications consultant,
- enroll in TI's course, *Graphics: What's Your Point? (GRAF)*,
- use Instant Chart on your PC.

The QMG offers two additional resources:

- a list of the names of staff who have developed expertise in using one or more of the QC tools, and
- copies of the software package, SOS

Call QMG for more information.

Graphs: Bar, Line, Pie

What are Graphs?

Graphs are visual displays of quantitative data. They lay out, describe, or summarize a set of numbers or statistics.

Graphs come in many different forms; some of the major ones are shown in detail in the following pages. In general, good graphs have these elements in common:

- A title describes what is portrayed in the graph.
- The vertical, or Y, axis represents FREQUENCY — how many times something has happened, percentage of something, number of dollars, etc.

Chart Form

Collected

| | |
|----------|--|
| By: | |
| On: | |
| At: | |
| Formula: | |

TL-2-15

- The horizontal, or X, axis represents distribution or division of the data — how often something happens (days, weeks, months), how many times things happened within a particular measure (how many data points between 7.34 and 7.45), etc. Both the X and Y axes should be clearly labeled.
- The scale used in a graph can be adjusted to show the situation, expanded to emphasize variables, compressed to show control. All graphs should have an indication of the total number of data points represented, as indicated by $n = \underline{\hspace{1cm}}$.

- If appropriate, the average of the data points in a sample is indicated by $\bar{X} = \underline{\hspace{1cm}}$.
- If there is a "good" direction, it should be indicated with an arrow.
- Every graph should indicate
 - when the data was gathered.
 - where it was gathered.
 - by whom it was gathered.
 - whether it is raw data, a percentage, averages.
 - how the data was calculated (a formula)

Why are Graphs Useful?

Because they visually display complex data, graphs aid us in understanding and interpreting data, and in speaking with facts.

When to Use Graphs

The following shows some of the types of graphs that are used throughout the QI Process and when they are most often used.

| Graph | Most Often Used In QI Story Step | | | | |
|--|----------------------------------|-------------------|----------|------------------|----------------------------------|
| | Reason for Improvement | Current Situation | Analysis | Counter-measures | Results Standardize Future Plans |
| Line, Bar, Pie Graphs | X | X | | | X |
| Pareto Chart | | X | X | | X |
| Cause and Effect Analysis (Fishbone Diagram) | | | X | | |
| Histogram | X | X | X | | |
| Scatter Diagram | X | | X | | |
| Control Chart | X | X | | | X |

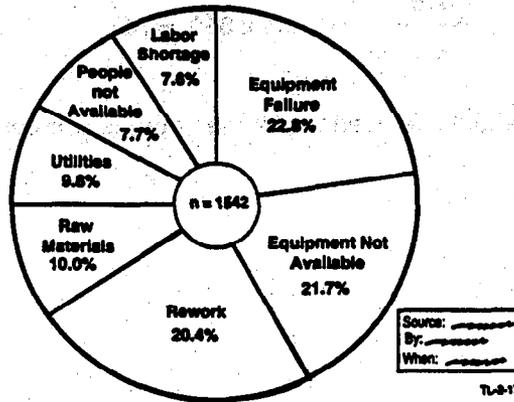
TM-7-06

Pie Chart

What is a Pie Chart?

A Pie Chart is a graphic representation which compares relative magnitudes or frequencies.

Production Delays by Type



Why is a Pie Chart Used?

It is used to show the percentage an item contributes to the whole.

How is a Pie Chart Constructed?

Divide a circle (pie) by several radii so that each wedge, for its respective item, represents the desired proportion of the whole.

To calculate the size of the wedge, divide the value of the item by the total value of all items, then multiply:

- by 100 to get percentage.

$$\frac{315}{1542} = .204 \times 100 = 20.4\% \\ \text{(rework, above)}$$

- by 360 to get degrees

$$\frac{315}{1542} = .204 \times 360 = 74^\circ$$

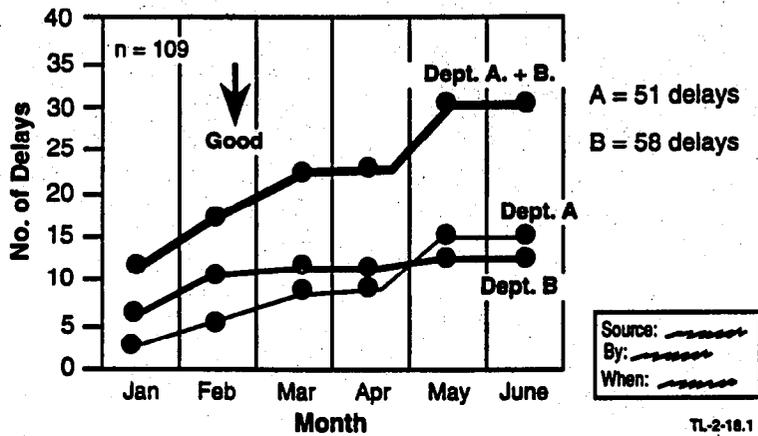
A protractor should be used to plot the degrees accurately.

Line Graph

What Is a Line Graph?

This graph is another way to visually display data for purposes of comparison. Specific data points are entered by number and then connected by a line.

Delays in Production in Departments A and B



Why Is a Line Graph Useful?

A line graph sketches an outline of a data pattern. It is easy to construct. Analysis of the shape of line graph provides information on which areas need future investigation.

How Is a Line Graph Constructed?

1. The center of each class interval is labeled on the horizontal axis.
2. A *trend line* displays some variable over a period of time. In the example above, the display is not of frequencies of occurrence, but of variable values (vertical axis) over time (horizontal axis).

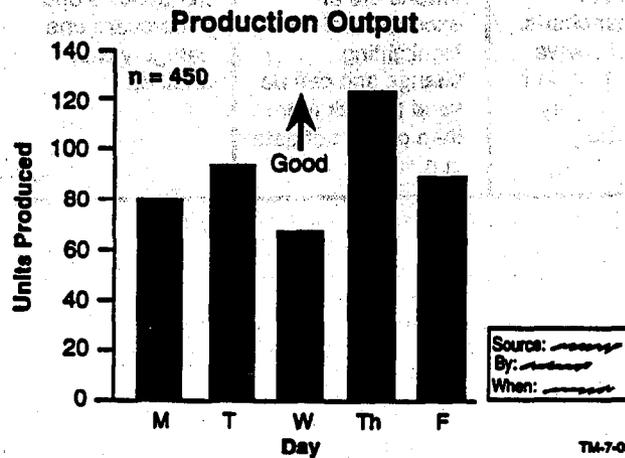
When using line graphs in your QI Story, follow these rules:

- a. If using several lines, the solid black line is of greatest emphasis. It should be your own unit or actual data. **Dotted lines are used for projections only.**
- b. If the line graph tracks data over time, ensure that the most recent data is shown.
- c. If the degree of conformance is above 80 percent, then track the degree of non-conformance.

Bar Chart

What is a Bar Chart?

A bar chart is a graphic representation which compares quantities by means of rectangles (bars) of uniform widths but of lengths proportional to the number being represented.



Why is a Bar Chart Used?

A bar chart presents a visual representation of data, thus making it easier to compare.

How is a Bar Chart Constructed?

On the horizontal (X) axis, show the items or things being compared through vertical bars of uniform width. On the vertical (Y) axis, show the quantities (frequencies of events in different locations, costs of different types of breakdowns, etc.) through the height of the bars. For a horizontal bar chart, reverse the labeling of the axes.

Comparison of the Advantages of the Pie, Line, and Bar Chart

| Pie Chart | Line Graph | Bar Chart |
|--|---|--|
| <p>This chart is useful for more than one level of stratification: all on one graph, equivalent to several bar charts. This chart shows relative proportion of each category to the whole.</p> | <p>Lines make trends and data variations over time easy to track. Line graphs are an excellent tool for highlighting change and can be used to track more than one set of data at a time.</p> | <p>Bars make it easier to recognize small differences in quantities or frequencies and to compare one category with another.</p> |

TM-7-10.1

Histogram

What is a Histogram?

1. A histogram (also called a frequency distribution) is a visual representation of the spread or distribution of data (for example, the height, in inches, of 36 employees). Information in a Histogram is represented by a series of rectangles or "bars" that are proportional in height to the frequency (Y axis) of the data groups or class sizes (X axis).
2. Since the class sizes or data groups are equal in size, the rectangles are of equal width. Therefore, the heights of these "bars" indicate the relative number of data points in each class.
3. The number of occurrences (frequency) is plotted on the Y axis and the data groups, or classes, are plotted on the X axis. To evaluate a histogram, we need to know the central tendency of the data, which shows how well the histogram is centered.

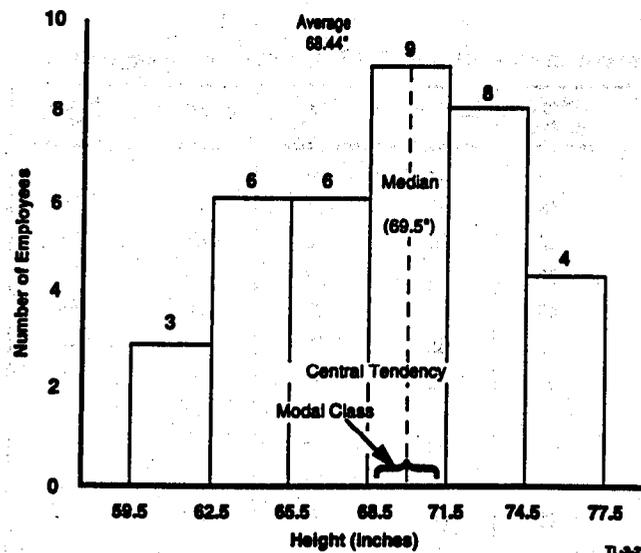
Checksheet of Heights of Our Employees for Histogram

| Employee | Height (Inches) | Employee | Height (Inches) | Employee | Height (Inches) |
|----------|-----------------|----------|-----------------|----------|-----------------|
| FV | 64 | GH | 69 | DG | 68 |
| BH | 63 | JH | 71 | MS | 72 |
| IW | 66 | BK | 73 | KH | 75 |
| BB | 73 | CZ | 62 | TG | 76 |
| CT | 60 | BS | 70 | CS | 69 |
| MM | 67 | GL | 65 | JS | 70 |
| GB | 68 | SS | 72 | LO | 72 |
| MF | 70 | DF | 63 | JD | 70 |
| JR | 65 | RK | 73 | JF | 76 |
| DR | 61 | BD | 74 | BH | 73 |
| MS | 66 | KM | 70 | KP | 65 |
| MC | 76 | CR | 66 | JB | 69 |

TL-221

4. The three measures of central tendency are:

- **Mean (average)** – the sum of all the measured, or counted, data divided by the total number of data points; for example, all the data points added together equal 2,462 divided by 36 = 68.44 inches.
- **Mode** – the value repeated most often in the raw data. In this example it is 70 inches. If the data is presented as grouped frequency like a histogram, we talk about *modal class* instead of the mode. Modal class is the class interval with the highest frequency. In this example, the modal class is 68.5 - 71.5.
- **Median** – the middle of all the measured or counted data points (if an even number of data points, the median will be a fraction); for example, in our data of 36 measurements, the median value is the average of the middle values (69 + 70 = 139 divided by 2 = 69.5 inches).



Why is a Histogram Useful?

1. It is not always easy to review a page of measured data and be able to recognize patterns or analyze what the data is trying to tell us. A histogram can provide information on the degree of variation of the data as well as indicate what distribution pattern we are working with. Drawing a curve around the heights of the bars of a histogram gives you the general shape.
2. Dispersion of the data can produce a wide variety of histogram shapes depending on the process or subject on which you have collected data. Some of the more common shapes are shown on the following page.

- a. **Normal Type (Example A)**

Normal (or "symmetric") type is the most commonly occurring histogram that we will use. Most values fall toward the center of the distribution (central tendency) with the variation balanced on both sides of the center (hence, giving a "bell-shaped" curve). As we begin applying other QC tools, such as Control Charts, we will focus on using *normal* distributions. The mode, median, and mean are the same.

- b. **Precipiced Type (Example B)**

Most of the values appear on the extreme left in Example B. This type of distribution could occur where there is a natural barrier or in cases where the data has been sorted (products which do not meet a particular specification limit are removed from the data set; or the failure rate of components).

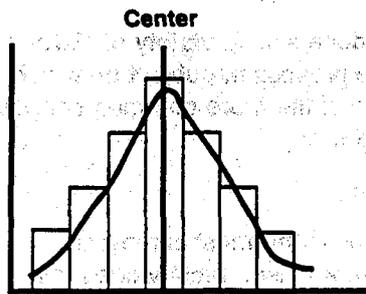
- c. **Skewed Type (Example C)**

A skewed type has a long tail on one side. There is more variation on one side than on the other, indicating

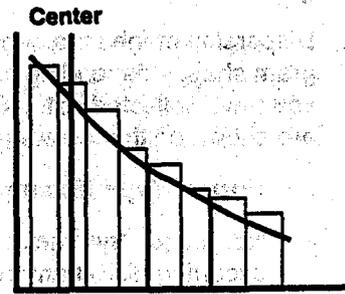
a shift of some variable during the process.

d. BI-Modal Type (Example D)

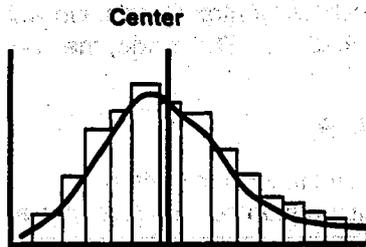
In a bi-modal (or twin-peaked) type, two peaks (two modes) appear. This usually occurs when two different data groups are mixed (a population of very short people is added to a population of extremely tall people). In effect, we have two histograms pushed together.



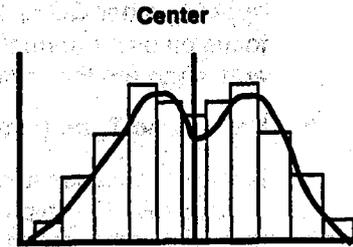
Example A: Normal



Example B: Precipiced



Example C: Skewed



Example D: BI-Modal

TL-2-23.1

How Is a Histogram Constructed?

| STEP | EQUATION | EXAMPLE |
|---|--|---|
| Start with an unorganized set of at least 30 data points. | | 64, 63, 66, 73, 60, 67, 68, 70, 65, 61, 66, 76, 69, 71, 73, 62, 70, 65, 72, 63, 73, 74, 70, 66, 68, 72, 75, 76, 69, 70, 72, 70, 76, 73, 65, 69 |
| Arrange the numbers in ascending or descending order. | | 60, 61, 62, 63, 63, 64, 65, 65, 65, 66, 66, 66, 67, 68, 68, 69, 69, 69, 70, 70, 70, 70, 70, 71, 72, 72, 72, 73, 73, 73, 73, 74, 75, 76, 76, 76 |
| Each number is a data point. Count the number of data points. | N | $N = 36$ |
| The range (R) of the set is the smallest (minimum) data point subtracted from the largest (maximum) data point. | $R = \text{MAX} - \text{MIN}$ | $N = 76 - 60$ $= 16$ |
| The class (K) is used to calculate the number of bars. Class equals the square root of N. Rule of thumb 6-12. | $K = \sqrt{N}$ | $K = \sqrt{36}$ $K = 6$ |
| The class width (H) is used to calculate the width of the bars. It is calculated by dividing the range by the class. | $H = R/K$ | $H = 16/6$ $H = 2.6$ (Round-up H) = 3 |
| To begin constructing the histogram, establish the starting point for the first class. This is calculated by subtracting from the minimum data point the measurement unit divided by 2. | Measurement Unit (M) $M = 1$ $\text{Min.} - M/2$ | $60 - 1/2 = 59.5$ |

TM-7-15

| STEP | EQUATION | EXAMPLE | | |
|--|----------|---|-------|-------|
| Now that the first class limit is established, construct a frequency table. | | Class Limits | Tally | Freq. |
| For Column 1, add to your starting point the class width (H). | $59 + H$ | $59.5 + 3$ Class Width is $59.5 - 62.5$ $62.5 - 65.5$, etc. | | |
| Column 2, go back to your original set of data points. Tally those that fall within each class limit. Add each item in Column 2 and enter the total frequency in Column 3. | | Class Limits | Tally | Freq. |
| | | 59.5 - 62.5 | | 3 |
| | | 62.5 - 65.5 | | 6 |
| | | 65.5 - 68.5 | | 6 |
| | | 68.5 - 71.5 | | 9 |
| | | 71.5 - 74.5 | | 8 |
| | | 74.5 - 77.5 | | 4 |

TM-7-16

To construct a graph, draw horizontal and vertical axes. The horizontal (X-axis) shows class intervals; the vertical (Y-axis) shows frequencies. Draw a bar to represent the frequency of data in each class. **The bars should be touching.**

When is a Histogram Used?

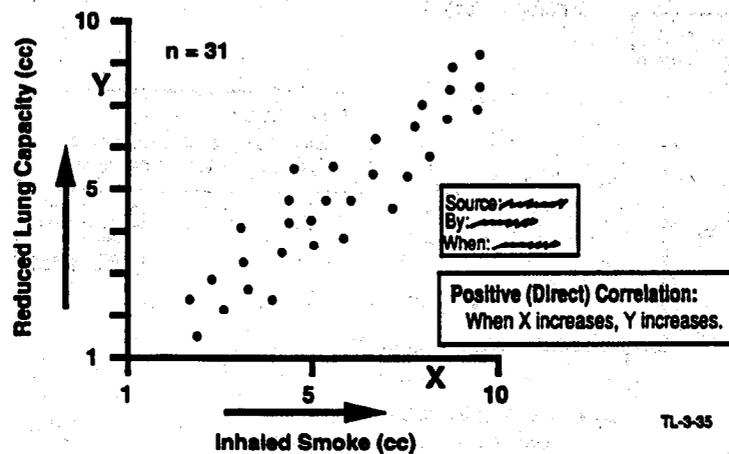
A histogram is especially useful in the *Current Situation* step of the QI Story when we want an accurate picture of the dispersion or spread of the data.

Scatter Diagram

What Is a Scatter Diagram?

A Scatter Diagram is a visual tool for showing the relationship between two variables (for example, speed and gas consumption, or hours worked and production output).

Example 1

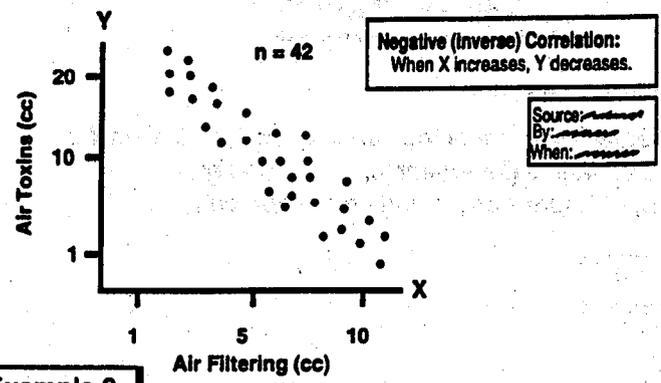


Why Is a Scatter Diagram Useful?

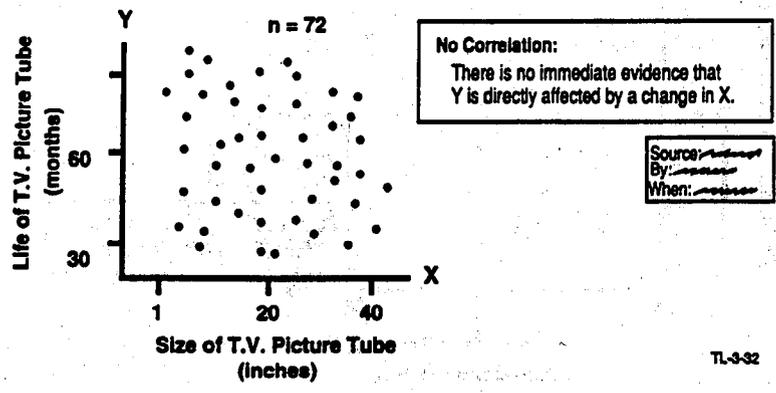
It shows clearly if there is a relationship, or correlation, between the two variables:

- Positive correlation — as X increases, so does Y.
- Negative correlation — as X increases, Y decreases.
- No correlation — one quantity has no particular relation to the other.

Example 2



Example 3



TL-332

How is a Scatter Diagram Constructed?

1. Collect at least 30 sets of paired data.
2. Find the lowest and highest values for X and Y. Determine the scales of the axes so that they are more or less equal in length, but try to have no more than 10 gradations. (Rule of thumb: between 3 and 10 gradations).

3. Arrange the axes so that the suspected driving factor (independent variable) is on the X axis and the one influenced by it (dependent variable) is on the Y axis. In example 1, showing the relationship between inhaled smoke and reduced lung capacity, "Inhaled Smoke" would go on the X axis and "Reduced Lung Capacity" on the Y axis, since inhaling smoke causes the *effect* of reducing lung capacity.

In example 2, the incidence of air toxins is decreased as the amount of air filtering increases. Air filtering causes a reduction in the amount of toxins, so it goes on the X axis.

Example 3 illustrates how the size of a T.V. picture tube (X axis) may cause change in the life of a T.V. picture tube (Y axis). The diagram shows no correlation.

4. Plot the data on the chart point by point; be sure to make the chart complete with the titles, dates, places, etc.
5. A correlation analysis of the data can be made. The correlation measure or coefficient is called "r"; "r" can have values from -1.0 to +1.0. The closer "r" is to +1.0, the stronger the positive correlation. The formula and guidance to calculate this correlation can be obtained from a statistical specialist.

When Is It Used?

The scatter diagram is probably most useful in the *Analysis* step for further examination of the elements isolated in cause and effect analysis; for example, it may verify a cause identified by the Ishikawa (Fishbone) Diagram. Care needs to be taken in plotting a scatter diagram to assure that a valid relationship is showing.

Control Charts: An Introduction

What are Control Charts?

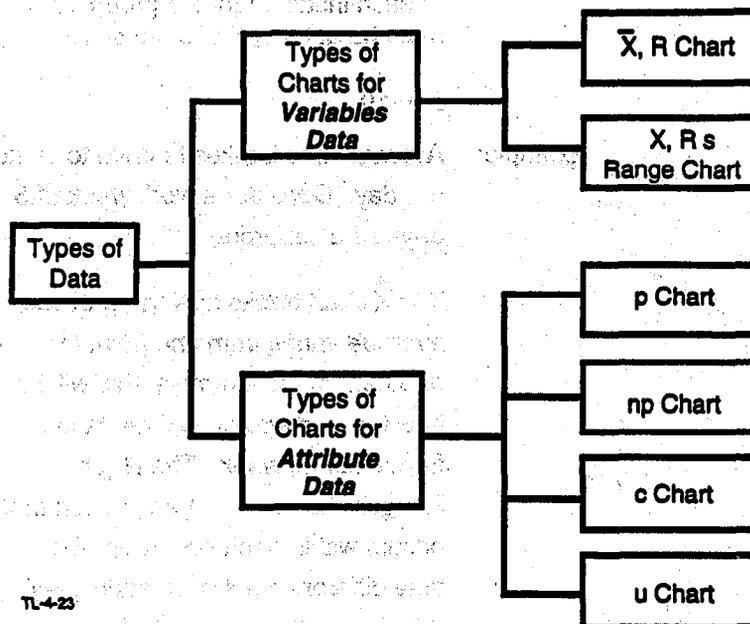
Control Charts are Line Graphs specifically used to track the trend or performance of an ongoing process. This is accomplished by observing how the variability within the process causes the trend line to fluctuate within a pair of statistically calculated limits. Control Charts illustrate process variability.

All natural processes are subject to variation. Even identical twins are often slightly different in height, weight, and looks. But how much variation is acceptable and what kinds of variation are controllable and, therefore, improvable?

When the fluctuations within the process occur in a non-random pattern or go outside a control limit, the process is statistically out of control. If action is not taken, the process stability is uncertain. This indicates opportunities for improvement.

Control limits are statistically derived from samples of a stable process. They are not to be confused with specification limits, which are determined by the Customer's Valid Requirements.

Control Charts can be classified into two main application groups depending on the type of data generated from the process. Below is a chart summarizing the types of Control Charts that will be discussed on the following pages.



TL-4-23

Variables Control Charts

- \bar{X} (X-bar) R Chart: This is a two-part control chart used to monitor processes with variables data. The number of items observed at each instance (or subgroup size) must be at least 2 or at most 10.

$2 < n < 10$

Example: Average time it takes to drive to work per day. Consider a work week of 5 days as a subgroup.

The \bar{X} chart tracks how the process average varies from one point to another. In the example, this will be how the average drive time varies from week to week. The R (or Range) chart tracks the variation that occurs within each subgroup (the time difference between each daily drive to work).

- X, R_s Chart: This two-part chart is used to monitor processes with variables data. It is similar to the \bar{X}, R chart, but the number of items observed at each instance is equal to 1. In other words, the X, R_s chart tracks how each process data point varies from another.

Attribute Control Charts

- **p Chart:** This is only a one-part control chart used to chart the process which generates attribute data. It is applicable to problems which deal with the *percentage* that do not conform to specifications.
Example: Percentage of jobs reworked per month.
- **np Chart:** This is a special type of p chart where the number of nonconformances is tracked from a fixed sample size at each observation point.
Example: Number of rejects found in a lot inspection with equal sample size at each inspection.
- **c Chart:** This chart tracks the number of nonconformances per unit.
Example: Number of customers who pay bills by the 5th of each month.
- **u Chart:** With the c chart, it is assumed that the probability of an occurrence (for example, an accident) is the same for each observation. But if we are considering the monthly number of outages per unit for a plant, the number of contributing units changes from month-to-month. As such, the probability of an occurrence is not the same each time.

The control chart used in this instance, where the opportunity for an occurrence is not the same, is called the u chart.

Why are Control Charts Useful?

Control Charts are helpful tools to monitor the performance of an ongoing process in determining the following:

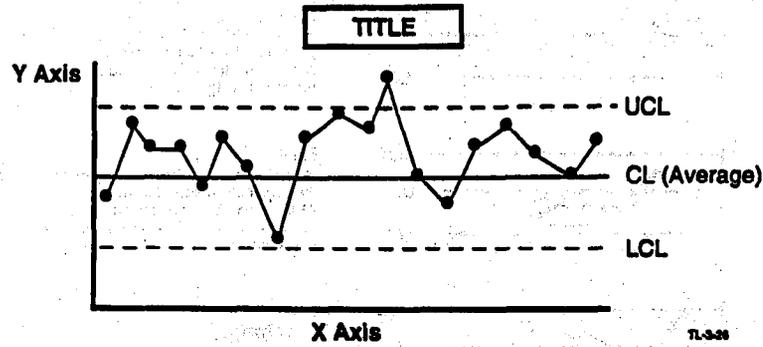
1. If the process is in control; or if action needs to be taken to keep the process in control; or if action needs to be taken to bring it back to control.
2. If the process is meeting the Customer's Valid Requirements.
3. If an opportunity for process or system improvement exists.
4. If any countermeasures have improved the process.

What Do Control Charts Look Like?

In general, Control Charts are line graphs in which the process is shown as a trend line drawn on a chart along with these three lines:

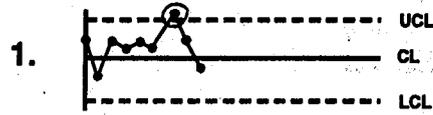
1. A mean, or central line, represents the average value of the process.
2. An upper control limit (UCL) drawn at a calculated distance above the central line which represents the maximum variation that could be expected if only normal/common causes of variation are present.
3. A lower control limit (LCL) drawn at a calculated distance below the central line which represents the minimum variation which could be expected if only normal/common causes of variation are present.

Below is an example of what a control chart may look like:



The X axis tracks time or sequential order, and the Y axis charts the factor being studied. The average of the process is indicated and control limits are added above and below the average.

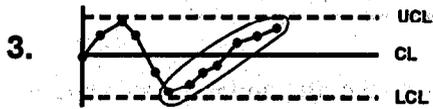
How Do We Interpret Control Charts ?



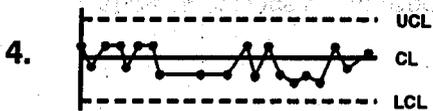
Point outside of the limit:
Control limits are calculated to measure the natural variability of a process. Any point on or outside the limit is considered abnormal and requires investigation.



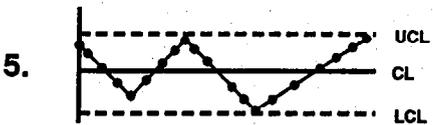
Run:
A "run" of seven points on one side of the center line is considered abnormal. Also considered abnormal: 10 out of 11, 12 of 14, or 18 of 20 points on one side of the center line.



Trending:
Seven points in a continuous upward or downward direction.

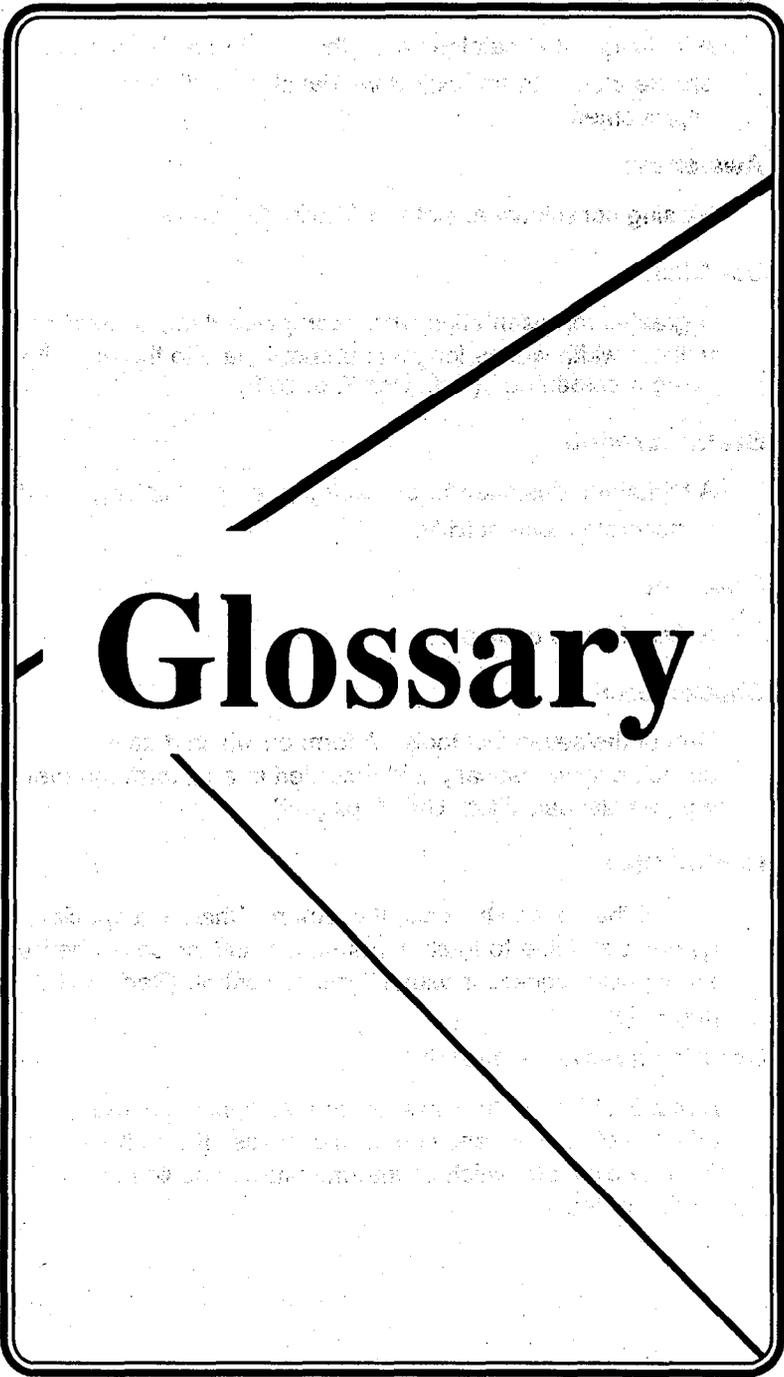


Approaching the center line (hugging):
When most points lie within the center line and 1.5σ it is not a controlled state and usually means the mixing of data from different populations. This makes the control limits too wide and stratification of data is usually necessary.



Cycling (periodicity):
Any repeated up and down trend is abnormal and requires investigation.

*Sigma (σ) is also commonly referred to as Standard Deviation



Glossary

Action Plan

A technique that catalogs everything that must be done to ensure a smooth and objective trial of a solution or improvement.

Awareness

Raising consciousness of the Quality Concepts.

Bar Chart

A graphic representation which compares items in bars of uniform width whose length is proportionate to the quantity being represented. (Ref: Unit 7, page 9)

Brainstorming

A technique designed to encourage creative thinking; used to generate ideas quickly.

Checklist

A list of items or steps.

Checksheets

One of the seven QC tools. A form on which data is collected systematically and recorded in a uniform manner, e.g., a calendar. (Ref: Unit 4, page 9)

Control Chart

One of the seven QC tools, the Control Chart is a special type of trend line to track performance and indicate whether an ongoing process is within limits or control. (Ref: Unit 7, page 20)

Countermeasures Matrix

A matrix of factors to help show the relationship between effect, root causes, and countermeasures. It also helps the team to evaluate which countermeasures should be implemented.

Cross-Functional Team

Brings together members from more than one functional group to work on improvement opportunities that cut cross functional lines. (Ref: Unit 2, page 14)

Customer Next Process

Process used to identify our customer's wants and reasonable expectations. A phrase which sums up the customer satisfaction orientation necessary to quality both for external and internal customers. (Ref: Unit 1, page 6)

Data

Any facts the team may be able to gather; can be in the form of numbers, words or pictures. (Ref: Unit 1, page 12)

Data Gathering Tools

Techniques used to collect useful data.

Estimating Cost of Problems

Technique used to determine the dollar impact of problems.

Facilitator

A trained coach, coordinator, promoter, communicator, and teacher of the QI Process. (Ref: Unit 2, page 11)

Fishbone

A diagram used to relate cause and effect to help determine possible root causes; sometimes called *Ishikawa* diagram after its inventor. (Ref: Unit 6, page 3)

Force Field Analysis

Elements resisting change (forces against). Elements pushing for change (forces for). Force Field Analysis is sometimes referred to as "Barriers and Aids."

Functional Team

Includes members from a single work reporting area. (Ref: Unit 2, page 14)

Histogram

A visual display of the information presented in a frequency distribution. A series of rectangles or bars proportionate in height to frequency of a particular class. Rectangles are of equal width. (Ref: Unit 7, page 11)

Interviewing

Technique used to obtain useful problem-related data from others.

Ishikawa (Fishbone) Diagram

A way to visually isolate an effect and to diagram possible related causes; can be used to identify the potential root causes of problems. This diagram was developed by Dr. Kaoru Ishikawa. (Ref: Unit 6, page 3)

Management Presentation

An opportunity for the team to describe their use of the QI process to their managers and to solicit management approval for implementation of the team's solution. The QI Story (a storyboard concept) is the standard method used to demonstrate use of the QI process.

Multivoting

Method of voting to help reduce a large number of items to a manageable few.

P-D-C-A

Plan-Do-Check-Act Cycle of continuous improvements. (Ref: Unit 2, page 7)

Pareto Analysis

A way of organizing data to show what major factor(s) make up the subject being analyzed. It is a search for significance.

Pareto Chart

Type of bar chart diagram to indicate what major factors affect the subject being analyzed. (Ref: Unit 5, page 3)

Problem

An undesired condition; a deviation from valid requirements.

Problem-Solving Process

A systematic approach to problem-solving which uses seven specific steps. (Ref: Unit 3, page 3)

Problem Statement

Describes in specific terms what is wrong or an undesirable situation. (Ref: Unit 5, page 9)

QC

Quality Control, the use of technical tools to analyze data.

Quality In Daily Work

Every employee's improvement of normal operations and systematic problem prevention in daily work. (Ref: Unit 1, page 3)

QI

Quality Improvement.

Quality

Conformance to valid requirements, or conformance to customer needs.

Quality Improvement Teams

Unit Quality Council, Cross-functional Team, Functional Team, Task Team. (Ref: Unit 2, page 15)

Quality Indicator

Measurement of the degree and/or frequency of conformance to valid requirements. (Ref: Unit 1, page 15)

Recognition

Personal satisfaction and external praise.

Root Cause

The major stimulus behind the undesired condition. (Ref: Unit 6, page 3)

Scatter Diagram

A visual technique for investigating the possibility of a causal relationship between two variables. (Ref: Unit 7, page 17)

Stratification

The breaking down of data into smaller related sub-groupings.

Sub-problem

A condition that relates to a problem.

Symptom

A condition where evidence of a problem is manifested.

TQM

Total Quality Management, another term for Quality Improvement.

Task Team

Members from one or more functional areas formed to solve a specific problem. Members are assigned because of background and experience. (Ref: Unit 2, page 14)

Team Leader

Guides the team through the problem-solving process. (Ref: Unit 2, page 10)

Team Member

Active participant on a team to solve problems and effect improvements. Shares experiences with other members. (Ref: Unit 2, page 9)

Tracking

A process to observe or monitor the steps or phases of an action plan to determine if desired results are obtained.

Theme Selection Matrix

A technique which helps the team to select a theme on which to begin gathering data. The matrix allows the team to rank its themes considering the impact on the customer and the need to improve. (Ref: Unit 4, page 7)

Trial Implementation

A first implementation of a countermeasure to check for success.

Unit Quality Council (Lead Team)

Region/Unit Quality Council (Lead Team) – team functions as a steering committee comprised of senior management.
Issue Area Quality Council – performs same role as Unit Quality Council but on issue are level. (Ref: Unit 2, page 14)

Valid Requirements

Specifications or standards which define the customer's expectations of a product or service. (Ref: Unit 1, page 8)

1947

...

...

...

...

...

...

...

...

...

...

...

...

...

...